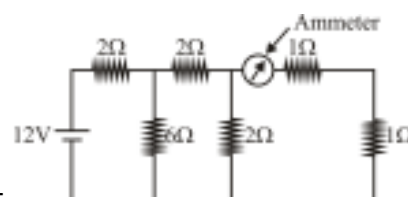


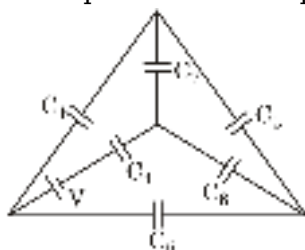
PHYSICS



1) In the circuit shown in figure the reading of ideal ammeter is :-

- (1) 1A
- (2) 2A
- (3) 3A
- (4) 4A

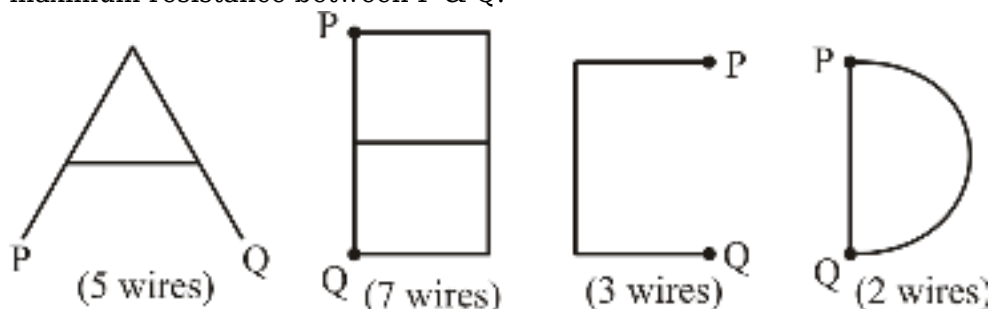
2) Diagram shows 6 identical air capacitors connected to an ideal battery (V). In this condition, charge on capacitor C_6 is Q_1 . Now a dielectric whose dielectric constant is 2, is put between the plates of C_4 so that it occupies the entire space between the plates. Now charge on C_6 becomes Q_2 .



Then $\frac{Q_1}{Q_2}$ should be:

- (1) $\frac{3}{4}$
- (2) $\frac{1}{2}$
- (3) $\frac{2}{1}$
- (4) $\frac{3}{2}$

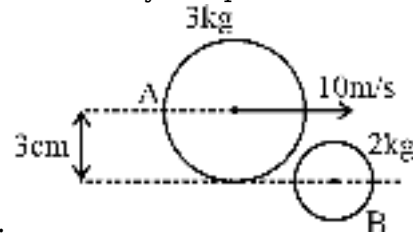
3) Wires are used to form the following letters. In each case the wire used have same cross-section area and resistivity. Length of each of straight portion of wire is same. Which letter will show maximum resistance between P & Q.



- (1) Letter A

- (2) Letter B
 (3) Letter C
 (4) Letter D

4) A ball of mass 3 kg and radius 3 cm moving with velocity of 10 m/s collides obliquely with another ball of mass 2 kg & radius 2 cm, kept at rest. The impact parameter is 3 cm. It is found that after collision, the 3 kg ball has a velocity component of 2 m/s along the common normal. Find the



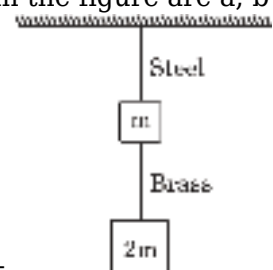
coefficient of restitution.

- (1) $\frac{1}{2}$
 (2) $\frac{8}{9}$
 (3) $\frac{7}{8}$
 (4) $\frac{2}{3}$

5) The over-bridge of a river is in the form of a circular arc of radius of curvature r . If m is the combined mass of the motorcycle and the rider crossing the bridge at a speed v at highest point. The normal on the bridge at the highest point will be :

- (1) $\frac{mv^2}{r}$
 (2) mg
 (3) $\frac{mv^2}{r} - mg$
 (4) $mg - \frac{mv^2}{r}$

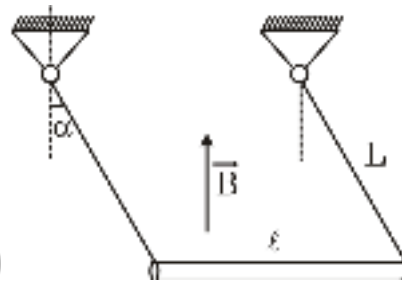
6) If the ratio of lengths, radii and Young's moduli of steel and brass wires in the figure are a , b and



c respectively, then the corresponding ratio of increase in their lengths is :-

- (1) $2a^2c/b$
 (2) $3a/2b^2c$
 (3) $2ac/b^2$
 (4) $3c/2ab^2$

7) The metal rod of length $\ell = 0.2$ m hung horizontally on two light wires of length $L = 0.1$ m in the vertical magnetic field with induction $B = 1$ Tesla. It is initially at $\alpha = 60^\circ$ from the equilibrium position and released (Fig.). Find the potential difference between the ends of the conductor at a



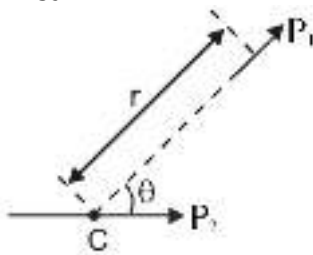
time when it passes the lowest position. ($g = 10 \text{ m/s}^2$)

- (1) Zero
- (2) 0.1 V
- (3) 0.2 V
- (4) $\frac{\sqrt{2}}{10} \text{ V}$

8) In an a.c. circuit the voltage applied is $E = E_0 \sin \omega t$. The resulting current in the circuit is $I = I_0 \sin \left(\omega t - \frac{\pi}{2} \right)$. The power consumption in the circuit is given by

- (1) $P = \sqrt{2} E_0 I_0$
- (2) $P = \frac{E_0 I_0}{\sqrt{2}}$
- (3) $P = \text{zero}$
- (4) $P = \frac{E_0 I_0}{2}$

9) Two short electric dipoles are placed as shown (r is the distance between their centres). The energy of electric interaction between these dipoles will be : (C is centre of dipole of moment P_2)



- (1) $\frac{2k P_1 P_2 \cos \theta}{r^3}$
- (2) $\frac{-2k P_1 P_2 \cos \theta}{r^3}$
- (3) $\frac{-2k P_1 P_2 \sin \theta}{r^3}$
- (4) $\frac{-4k P_1 P_2 \cos \theta}{r^3}$

10)

A charge $+q$ is fixed at each of the points $x = x_0, x = 3x_0, x = 5x_0 \dots$ ad Inf. on the x-axis, and a charge $-q$ is fixed at each of the points $x = 2x_0, x = 4x_0, x = 6x_0, \dots$ ad inf. Here x_0 is a positive constant. Take the electric potential at a point due to a charge Q at a distance r from it to be $Q/(4\pi\epsilon_0 r)$. Then, the potential at the origin due to the above system of charges is.

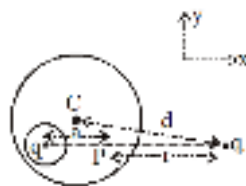
(1) Zero

(2) $\frac{q}{8\pi\epsilon_0 x_0 \log_e 2}$

(3) ∞

(4) $\frac{q \log_e 2}{4\pi\epsilon_0 x_0}$

11) A charge q is placed inside a spherical cavity made in uncharged conducting sphere of radius R as shown. A point charge q_0 is placed at a separation d from centre of the solid sphere. Electric field



at P due to all the induced charges on sphere will be.

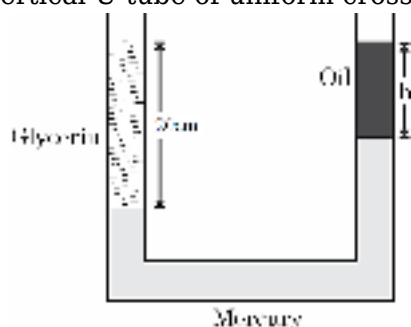
(1) $\frac{q_0}{4\pi\epsilon_0 r^2} (-\hat{i})$

(2) $\left(\frac{q_0}{4\pi\epsilon_0 r^2} - \frac{q}{4\pi\epsilon_0 a^2} \right) (-\hat{i})$

(3) $\left(\frac{q_0}{4\pi\epsilon_0 r^2} - \frac{q}{4\pi\epsilon_0 a^2} \right) (+\hat{i})$

(4) Zero

12) A vertical U-tube of uniform cross-section contains mercury in both sides of its arms as shown



below :

Glycerin column of 20cm is introduced into one of its arms and oil of density 0.8g/cc is poured into other arm until the upper surface of oil and glycerin are at same horizontal level [$\rho_{\text{Hg}} = 13.6\text{ g/cc}$, $\rho_{\text{glycerine}} = 1.3\text{ g/cc}$] length of oil column is :

(1) 20.8 cm

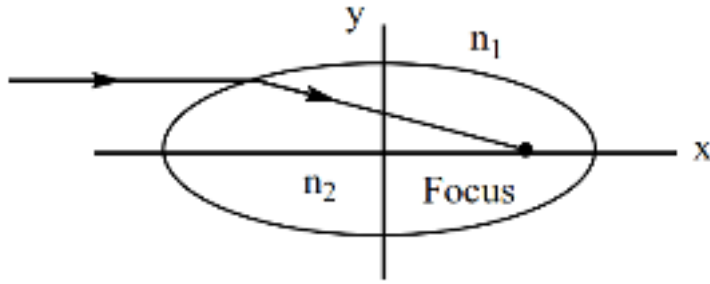
(2) 19.2 cm

(3) 17.2 cm

(4) 20 cm

13) A body of elliptical cross - section is made up of material of refractive index n_2 . The body is surrounded by a liquid of refractive index n_1 . The figure here shows a cross - section of this body. If

any ray parallel to major axis of the cross - section passes through focus of the cross - section (as shown), then the eccentricity of the elliptical cross - section is



(1) $\frac{n_1}{n_2}$

(2) $\frac{1}{\sqrt{n_1 n_2}}$

(3) $\frac{2}{n_1 + n_2}$

(4) $\frac{n_1 n_2}{n_2 - n_1}$

14) Two thin symmetrical lenses of different nature have equal radii of curvature $R = 20$ cm. The lenses are put close together and immersed in water. The converging focal length of the system is $24\frac{4}{3}$ cm. Find the difference between refractive indices of the two lenses. (refractive index for water = $\frac{4}{3}$)

(1) $(\mu_1 - \mu_2) = \frac{1}{24}$

(2) $(\mu_1 - \mu_2) = \frac{1}{20}$

(3) $(\mu_1 - \mu_2) = \frac{5}{9}$

(4) $(\mu_1 - \mu_2) = \frac{4}{3}$

15) Two stars of mass m and $3m$ separated by distance r are moving in circular path about their centre of mass due to mutual gravitation force. The angular velocity of any star will be

(1) $\sqrt{\frac{Gm}{4r^3}}$

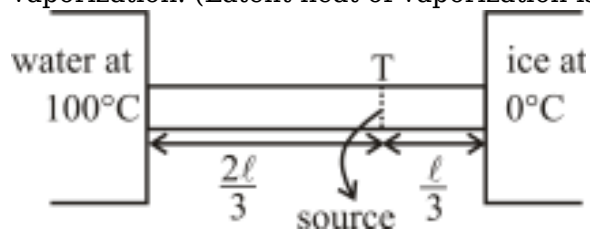
(2) $\sqrt{\frac{2Gm}{r^3}}$

(3) $\sqrt{\frac{4Gm}{r^3}}$

(4) $\sqrt{\frac{Gm}{2r^3}}$

16) The rod connecting two reservoir and connected to a source is as shown in diagram. The rod is

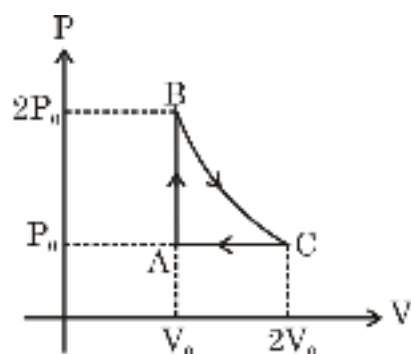
in steady state. Find the temperature of source, so that rate of melting of ice is 16 times that rate of vaporization. (Latent heat of vaporization is 540 Cal/gm and latent heat of fusion is 80 Cal/gm)



- (1) 540° C
- (2) 580° C
- (3) 640° C
- (4) 740° C

17)

A monatomic gas goes through cyclic process shown in P-V curve. The efficiency of cycle is :
[Process BC is isothermal]



- (1) $\frac{2\ln 4 - 2}{3 + 2\ln 4}$
- (2) $\frac{\ln 2 - 1}{1 + \ln 2}$
- (3) $\frac{4}{23}$
- (4) $\frac{\ln 2 - 1}{2 + \ln 2}$

18) A toy plane is flying horizontally at 10 m/s at height 80 m above the ground towards a man on the ground as shown. When plane is 60m away horizontally from man, a ball is dropped by the plane. Find speed of man (assumed uniform) so that he is able to catch the ball just before it strikes the

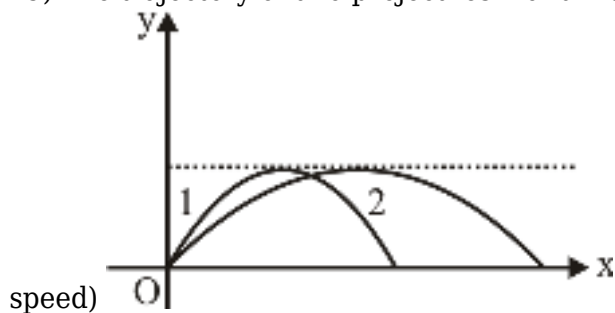


ground ($g = 10 / s^2$) :-

- (1) 10 m/s
- (2) 15 m/s

- (3) 5 m/s
(4) 7.5 m/s

19) The trajectory of two projectiles 1 and 2 as shown in the figure (T is time of flight, V_0 is projected

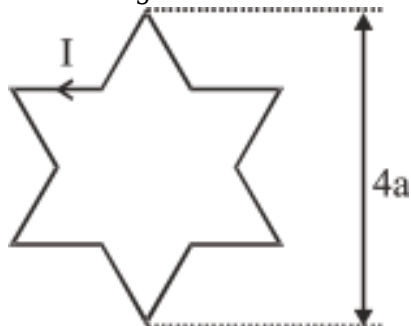


- (1) $T_1 = T_2$ & $v_{01} > v_{02}$
(2) $T_1 < T_2$ & $v_{01} < v_{02}$
(3) $T_1 > T_2$ & $v_{01} < v_{02}$
(4) $T_1 = T_2$ & $v_{01} < v_{02}$

20) A solid cylindrical wire of radius 'R' carries a current 'I'. The magnetic field is $5\mu\text{T}$ at a point, which is '2R' distance away from the axis of wire. Magnetic field at a point which is $R/3$ distance inside from the surface of the wire is :-

- (1) $\frac{10}{3}\mu\text{T}$
(2) $\frac{20}{3}\mu\text{T}$
(3) $\frac{5}{3}\mu\text{T}$
(4) $\frac{40}{3}\mu\text{T}$

21) A symmetric star shaped conducting wire loop is carrying a steady state current I as shown in the figure. The distance between the diametrically opposite vertices of the star is $4a$. The magnitude of the magnetic field at the center of the loop is :



- (1) $\frac{\mu_0 I}{4\pi a} 3 [\sqrt{3} - 1]$
(2) $\frac{\mu_0 I}{4\pi a} 6 [\sqrt{3} - 1]$

$$(3) \frac{\mu_0 I}{4\pi a} 6 [\sqrt{3} + 1]$$

$$(4) \frac{\mu_0 I}{4\pi a} 3 [2 - \sqrt{3}]$$

22) A stationary singly ionised helium atom emits a photon corresponding to the first line of Lyman series. The emitted photon is then absorbed by a stationary hydrogen atom in the ground state. Point correct statements/s from the following :-

(1) The emitted photon from He^+ ion excites the hydrogen atom to sixth excited state.

The kinetic energy of recoiling of He^+ of mass m when it emits a photon of frequency ν is given

$$(2) \frac{h^2 \nu^2}{2mc^2}.$$

(3) The emitted photon from He^+ ion ionises the hydrogen atom with liberated electron carrying kinetic energy of about 20 eV.

(4) The transition energy during the emission of photon from He^+ ion is about 54.4 eV.

23) A free particle with initial kinetic energy E and zero potential energy and de-broglie wavelength λ , enters a region in which it has potential energy V . What is the particle's new wavelength?

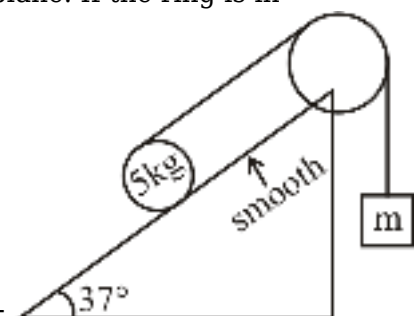
$$(1) \lambda \left(1 - \frac{E}{V}\right)^{-1}$$

$$(2) \lambda \left(1 - \frac{V}{E}\right)^{-1}$$

$$(3) \lambda \left(1 - \frac{E}{V}\right)^{-\frac{1}{2}}$$

$$(4) \lambda \left(1 - \frac{V}{E}\right)^{-\frac{1}{2}}$$

24) Ring of mass "5kg" and radius 1 m is placed on a smooth incline plane. If the ring is in



translatory equilibrium find the mass of the block shown in diagram :-

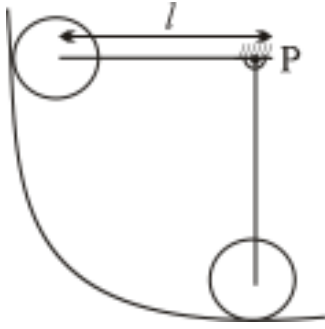
(1) 3 kg

(2) 7.5 kg

(3) 10 kg

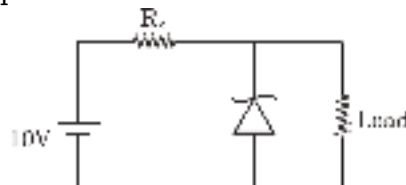
(4) This situation is not possible

25) A sphere of mass M and radius R is attached by a light rod of length ℓ to a point P . The sphere rolls without slipping on a circular track as shown. It is released from the horizontal position. The angular momentum of the system about P when the rod becomes vertical is :



- (1) $M\sqrt{\frac{10}{7}g\ell}[\ell + R]$
- (2) $M\sqrt{\frac{10}{7}g\ell} \left[\ell + \frac{2}{5}R \right]$
- (3) $M\sqrt{\frac{10}{7}g\ell} \left[\ell + \frac{7}{5}R \right]$
- (4) $M\sqrt{\frac{10}{7}g\ell} \left[\ell - \frac{2}{5}R \right]$

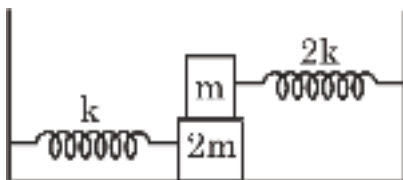
26) In a Zener regulated power supply a Zener diode with $V_z = 6.0 \text{ V}$ is used for regulation. The load current is to be 4.0 mA and the unregulated input is 10.0 V . What should be the value of series



resistor R_s ? Choose zener current to be 20mA .

- (1) 163Ω
- (2) 167Ω
- (3) 175Ω
- (4) 186Ω

27) In the shown arrangement, the coefficient of friction between the blocks is μ and no friction between ground surface and block $2m$. The blocks are displaced slightly and released. They move together without slipping on each other. The time period will be :-



- (1) $2\pi\sqrt{\frac{m}{k}}$
- (2) $2\pi\sqrt{\frac{3m}{2k}}$
- (3) $2\pi\sqrt{\frac{2m}{3k}}$

(4) $2\pi\sqrt{\frac{9m}{2k}}$

28)

A wave is represented by the equation

$$y = 7 \sin \left(7\pi t - 0.04\pi x + \frac{\pi}{3} \right)$$

x is in metres and t is in seconds. The speed of the wave is

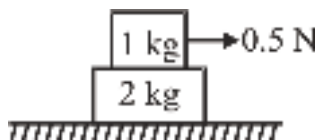
- (1) 175 m/s
- (2) 49π m/s
- (3) $49/\pi$ m/s
- (4) 0.28π m/s

29) At a point P on the screen at distance D from the slits in standard YDSE experiment, 3rd maxima is observed at t = 0. Now screen is slowly moved with constant speed away from the slits in such a way that the centre of slits and centre of screen always lie on same line and at t = 1 sec, the

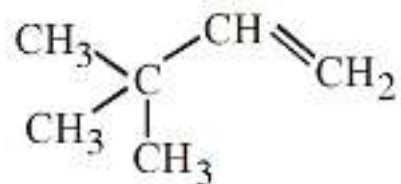
intensity at point P is observed to be $\left(\frac{3}{4}\right)^{\text{th}}$ of maximum intensity in between 2nd and 3rd maxima. The speed of screen can be :-

- (1) $\frac{5D}{13}$
- (2) $\frac{13D}{5}$
- (3) $\frac{17D}{5}$
- (4) $\frac{7D}{17}$

30) A force of 0.5 N is applied on the upper block as shown in figure. The coefficient of static friction between the two blocks is 0.1 and that between the lower block and the surface is zero. The work done by the lower block on the upper block for a displacement of 3 m of the upper block is :-

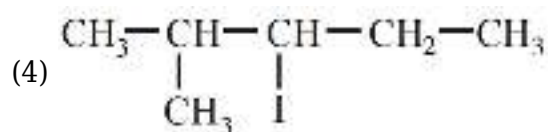
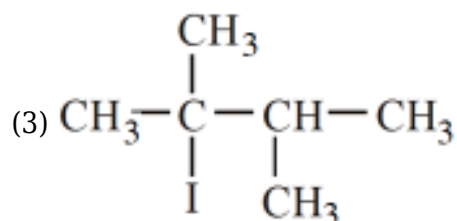
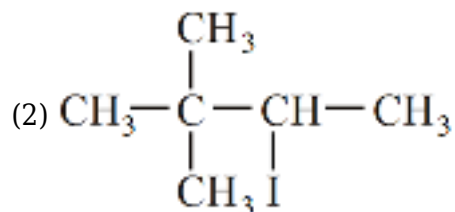
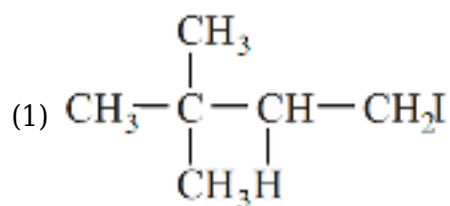


- (1) 1 J
- (2) -1 J
- (3) 2 J
- (4) -2 J



1) What is the major product formed by HI on reaction with

?



2) Match List-I and List-II.

	List-I		List-II
(a)	Valium	(i)	Antifertility drug
(b)	Morphine	(ii)	Pernicious anaemia
(c)	Norethindrone	(iii)	Analgesic
(d)	Vitamin B ₁₂	(iv)	Tranquilizer

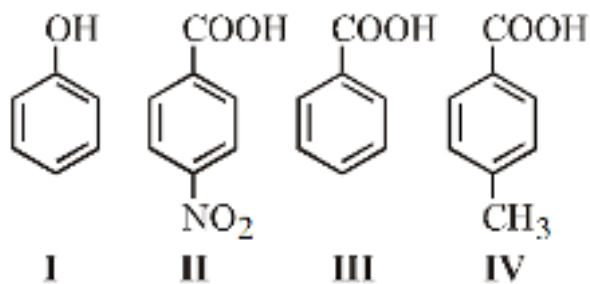
(1) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(2) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

(3) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

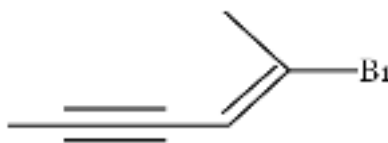
(4) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

3) The correct order of acid character of the following compounds is :



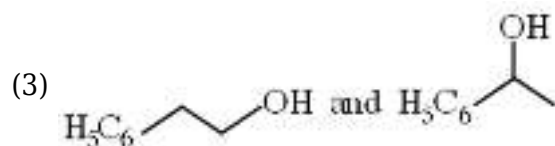
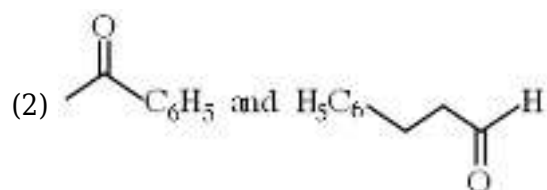
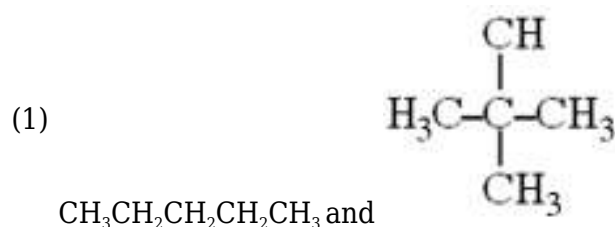
- (1) III > II > I > IV
 (2) IV > III > II > I
 (3) I > II > III > IV
 (4) II > III > IV > I

4) Choose the **correct** name for compound given below :



- (1) (4E)-5-Bromo-hex-4-en-2-yne
 (2) (2E)-2-Bromo-hex-4-yn-2-ene
 (3) (2E)-2-Bromo-hex-2-en-4-yne
 (4) (4E)-5-Bromo-hex-2-en-4-yne

5) Which one of the following pairs of isomers is an example of metamerism ?



6) Given below are two statements :

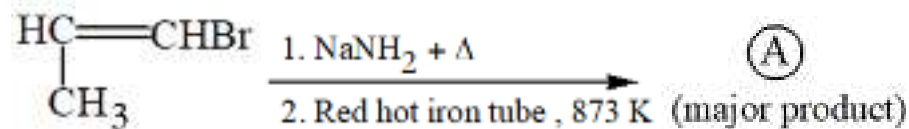
Statement-I : 2-methylbutane on oxidation with KMnO_4 gives 2-methylbutan-2-ol.

Statement-II : n-alkanes can be easily oxidised to corresponding alcohol with KMnO_4 .

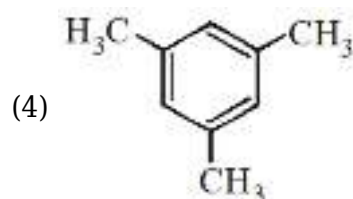
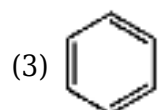
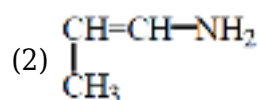
Choose the correct option :

- (1) Both statement I and statement II are correct
- (2) Both statement I and statement II are incorrect
- (3) Statement I is correct but Statement II is incorrect
- (4) Statement I is incorrect but Statement II is correct

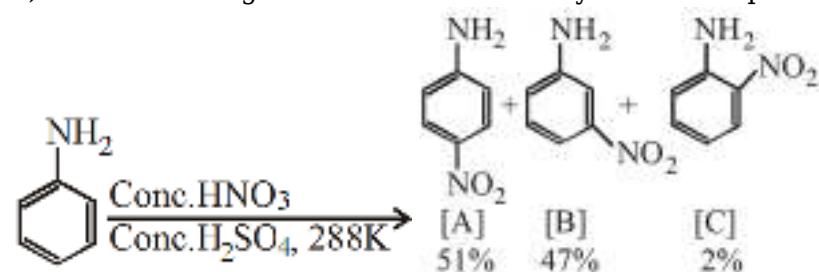
7) For the given reaction :



- (1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

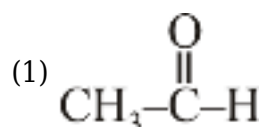


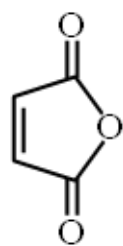
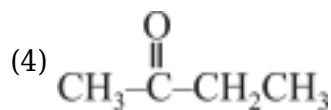
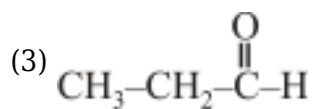
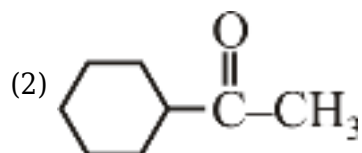
8) In the following reaction the reason why meta-nitro product also formed is :



- (1) low temperature
- (2) $-\text{NH}_2$ group is highly meta-directive
- (3) Formation of anilinium ion
- (4) $-\text{NO}_2$ substitution always takes place at meta-position

9) Which one of the following carbonyl compounds cannot be prepared by addition of water on an alkyne in the presence of HgSO_4 and H_2SO_4 ?





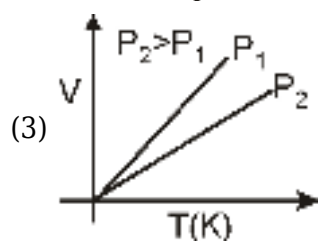
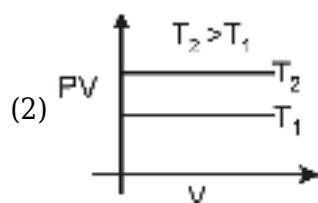
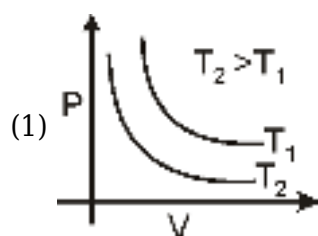
10)

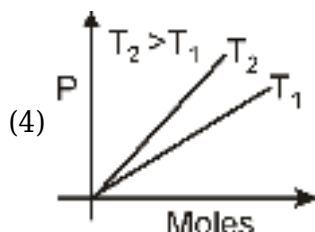
Maleic anhydride

Maleic anhydride can be prepared by :

- (1) Heating trans-but-2-enedioic acid
- (2) Heating cis-but-2-enedioic acid
- (3) Treating cis-but-2-enedioic acid with alcohol and acid
- (4) Treating trans-but-2-enedioic acid with alcohol and acid

11) Which of the following graph is/are inconsistent with ideal gas behaviours?





12) Select incorrect statement:

- (1) We can condense vapour simply by applying pressure
- (2) To liquefy a gas, one must lower the temperature below its critical temperature (T_c) and also apply pressure
- (3) At critical temperature (T_c), there is no distinction between liquid and vapour state. Hence, density of the liquid is nearly equal to density of the vapour
- (4) Whatever the pressure applied, a gas cannot be liquified below its critical temperature (T_c)

13)

In an experiment, 50 mL of 0.1 M solution of a metal salt reacted with 25 mL of 0.1 M solution of sodium sulphite. The half equation for the oxidation of sulphite ion is

$\text{SO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\ell) \rightarrow \text{SO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^-$ If the oxidation number of metal in the salt was 3, what would be the new oxidation number of metal ?

- (1) Zero
- (2) 1
- (3) 2
- (4) 4

14) Element X react with oxygen to produce a pure sample of X_2O_3 . In an experiment it is found that 1.00 g of X produces 1.16 g of X_2O_3 . Calculate the atomic weight of X. Given atomic weight of oxygen, 16.0 g mol⁻¹.

- (1) 67
- (2) 100.2
- (3) 125
- (4) 150

15) Which of the following statement is incorrect -

- (1) During electrophoresis, colloidal particle move under influence of electric field
- (2) Higher is the coagulating power of an electrolyte, higher is its coagulation value.
- (3) Less is the gold number, better is protective power of lyophilic colloid
- (4) Sorption process is a combination of adsorption and absorption process.

16)

Which one is correct among the following ?

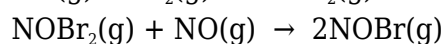
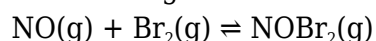
If $E_{\text{Cu}^{2+}/\text{Cu}}^0 = 0.3\text{V}$, $E_{\text{Cu}^+/\text{Cu}}^0 = 0.5\text{V}$

- (1) Cu^+ disproportionates
- (2) Cu and Cu^{2+} can not co-exist with each other in solution
- (3) $(E_{\text{Cu}/\text{Cu}^{2+}}^0 - E_{\text{Cu}^+/\text{Cu}}^0)$ is positive
- (4) $E_{\text{Cu}^{2+}/\text{Cu}^+}^0 = 0.2 \text{ V}$

17) For first order reaction $\text{A} \rightarrow 2\text{B}$ initial concentration of A was 0.8 M and after 1 min. conc. of [B] was 0.8 M. Half-life period for reaction is :

- (1) 60 sec.
- (2) 120 sec.
- (3) 180 sec.
- (4) 30 sec.

18) The following mechanism has been proposed for the reaction of NO with Br_2 to form NOBr :



If the second step is the rate determining step, the order of the reaction with respect to NO(g) is

- (1) 2
- (2) 1
- (3) 0
- (4) 3

19) At 25°C and 1 atm pressure, the enthalpies of combustion are as given below :

Substance	H_2	C(graphite)	$\text{C}_2\text{H}_6(\text{g})$
$\frac{\Delta_c H^\ominus}{\text{kJ mol}^{-1}}$	-286.0	-394.0	-1560.0

The enthalpy of formation of ethane is :

- (1) $+54.0 \text{ kJ mol}^{-1}$
- (2) $-68.0 \text{ kJ mol}^{-1}$
- (3) $-86.0 \text{ kJ mol}^{-1}$
- (4) $+97.0 \text{ kJ mol}^{-1}$

20) Which of the following aqueous solutions is isotonic with 15 % $\frac{w}{w}$ glucose aqueous solution with specific gravity of 1.2 ?

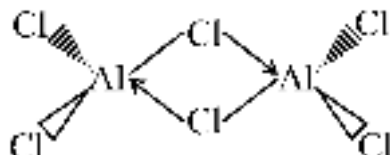
- (1) 1 M CaCl_2
- (2) 1 N CaCl_2
- (3) 0.5 M NaCl
- (4) 0.5 M urea

21) Select correct order.

- (1) $F^- > Cl^-$: Ionisation energy
- (2) $O > Cl$: 1st Electron affinity
- (3) $O > F > N$: 2nd ionisation energy
- (4) $H^- < Cl^-$: ionic size

22)

Consider the structure of Al_2Cl_6 and choose correct statement



- (1) It is planar molecule
 - (2) Hybridisation state of Al is sp^3
 - (3) It has $3c-2e^-$ and $2c-2e^-$ bonds
 - (4) Al_2Cl_6 is electron deficient molecule
- 23) The xenon compound(s) that are iso-structural with IBr_2^- (linear) and BrO_3^- (trigonal pyramidal) respectively are :

- (1) Linear XeF_2 and pyramidal XeO_3
- (2) Bent XeF_2 and pyramidal XeO_3
- (3) Bent XeF_2 and planar XeO_3
- (4) Linear XeF_2 and trigonal planar XeO_3

24) Which of the following complex is colourless ?

- (1) $Zn_2[Fe(CN)_5(NOS)]$
 - (2) $[Cu(NH_3)_4SO_4]$
 - (3) $K_3[Cu(CN)_4]$
 - (4) $[Ti(H_2O)_6]Cl_3$
- 25) $2[M(CN)_2]^- (aq.) + Zn(s) \rightarrow [Zn(CN)_4]^{2-} (aq.) + 2M(s)$
In above reaction "M" may be -

- (1) Ag
 - (2) Pb
 - (3) Mg
 - (4) Hg
- 26) Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii ? (Numbers in the parenthesis are atomic numbers).

- (1) Zr (40) and Nb (41)
- (2) Zr (40) and Hf (72)

(3) Zr (40) and Ta (73)

(4) Ti (22) and Zr (40)

27) $\text{CuCl}_2 + (\text{X})_{(\text{g})} + \text{H}_2\text{O} \rightarrow \text{Cu}_2\text{Cl}_2$; X is :

(1) CO_2

(2) C_3O_2

(3) SO_2

(4) N_2O_5

28) When 'A' salt solution is added carefully to a saturated solution of Fe(II) sulphate acidified with dilute H_2SO_4 a brown ring is formed at the junction of two liquids. The compound A is

(1) NaNO_3

(2) NaNO_2

(3) NaCl

(4) Na_2SO_3

29) Which of the following is **INCORRECT** :

(1) BeCO_3 is kept in the atmosphere of CO_2 since, it is thermally unstable

(2) Sodium peroxy borate used in washing powder as brightener

(3) Sodium hydrogen carbonate is made by saturating a solution of sodium carbonate with carbon dioxide

(4) Gypsum when added to cement makes the setting of the cement faster.

30) CFCl_3 is responsible for the decomposition of ozone to form oxygen. Which of the following reacts with ozone to form oxygen ?

(1) Cl_2

(2) Cl^-

(3) F^-

(4) $\text{C}\overset{\cdot}{\underset{\cdot}{\text{I}}}$

ENGLISH PROFICIENCY

1) **Directions** : in each of the following questions, choose the most appropriate alternative to fill in the blanks.

Riya looked tired, but she said she ____ finish the project before midnight if necessary.

(1) can

(2) could

(3) might

(4) would

2) Identify the sentence that uses the **relative pronoun** correctly.

- (1) The scientist which discovered the particle won international recognition.
- (2) The conference, what was scheduled for April, has been postponed.
- (3) The woman whom you spoke to yesterday is leading the research now.
- (4) This is the painting what my grandmother gifted me.

3) Choose the correct form of the verb:

Neither of the solutions offered by the committee ____ acceptable to the panel.

- (1) were
- (2) have been
- (3) is
- (4) are

4) Choose the correctly spelled word.

- (1) Accomodation
- (2) Accommodation
- (3) Accommodation
- (4) Accommodation

5) Choose the alternative which is most nearly the same in meaning to the word given in capital letters. "CIRCUMSPECT."

- (1) Lazy
- (2) Cautious
- (3) Reckless
- (4) Ambitious

6) Choose the alternative which is opposite in meaning to the word given in capital letters. "FORTIFY"

- (1) Strengthen
- (2) Secure
- (3) Weaken
- (4) Intensify

7) **Directions :** Read the follow carefully and answer the questions that follow :

Despite significant technological advancement, modern societies continue to face challenges in balancing productivity with well-being. Studies indicate that individuals who allocate even brief intervals of time to reflection or mindful disengagement experience improved focus and emotional resilience. Interestingly, organizations that encourage such practices often report higher levels of creativity among employees. However, a persistent misconception remains: many assume that constant activity equates to greater efficiency. Researchers argue that this belief not only undermines long-term performance but also contributes to burnout, suggesting that sustainable productivity emerges from a harmonious blend of effort and recuperation.

According to the passage, what misconception exists in modern workplaces?

- (1) Employees prefer reflection over activity.
- (2) Constant activity automatically increases efficiency.
- (3) Creativity is unrelated to well-being.
- (4) Only long breaks improve productivity

8) **Directions :** Read the follow carefully and answer the questions that follow :

Despite significant technological advancement, modern societies continue to face challenges in balancing productivity with well-being. Studies indicate that individuals who allocate even brief intervals of time to reflection or mindful disengagement experience improved focus and emotional resilience. Interestingly, organizations that encourage such practices often report higher levels of creativity among employees. However, a persistent misconception remains: many assume that constant activity equates to greater efficiency. Researchers argue that this belief not only undermines long-term performance but also contributes to burnout, suggesting that sustainable productivity emerges from a harmonious blend of effort and recuperation.

In the passage, the word “harmonious” most nearly means:

- (1) Conflicted
- (2) Balanced
- (3) Artificial
- (4) Gradual

9) **Directions :** Read the follow carefully and answer the questions that follow :

Despite significant technological advancement, modern societies continue to face challenges in balancing productivity with well-being. Studies indicate that individuals who allocate even brief intervals of time to reflection or mindful disengagement experience improved focus and emotional resilience. Interestingly, organizations that encourage such practices often report higher levels of creativity among employees. However, a persistent misconception remains: many assume that constant activity equates to greater efficiency. Researchers argue that this belief not only undermines long-term performance but also contributes to burnout, suggesting that sustainable productivity emerges from a harmonious blend of effort and recuperation.

Which of the following best summarizes the **central idea** of the passage?

- (1) Productivity is improved by working for longer hours without interruption.
- (2) Reflective breaks can enhance resilience, creativity, and long-term efficiency.
- (3) Technological advancements have eliminated workplace burnout.
- (4) Organizations cannot influence employee well-being.

10) **Directions :** Read the follow carefully and answer the questions that follow :

Despite significant technological advancement, modern societies continue to face challenges in balancing productivity with well-being. Studies indicate that individuals who allocate even brief intervals of time to reflection or mindful disengagement experience improved focus and emotional resilience. Interestingly, organizations that encourage such practices often report higher levels of creativity among employees. However, a persistent misconception remains: many assume that constant activity equates to greater efficiency. Researchers argue that this belief not only undermines long-term performance but also contributes to burnout, suggesting that sustainable productivity emerges from a harmonious blend of effort and recuperation.

Which linker would BEST replace the underlined words to maintain logical flow?

Constant activity may seem productive, **but in reality**, it can hinder long-term efficiency.

- (1) Therefore
- (2) Nevertheless
- (3) Meanwhile
- (4) As a result

LOGICAL REASONING

1) **Direction :** In each of the following questions, there are two words to the left of the sign :: which are connected in some way. The same relationship obtains between the third word and one of the four alternatives under it. Find the correct alternative in each question.

Man : Walk :: Fish : ?

- (1) Swim
- (2) Eat
- (3) Live
- (4) Sleep

2) **Direction :** In each of the following questions, there are two words to the left of the sign :: which are connected in some way. The same relationship obtains between the third word and one of the four alternatives under it. Find the correct alternative in each question.

Import : Export :: Expenditure : ?

- (1) Deficit
- (2) Revenue
- (3) Debt
- (4) Tax

3) **Direction :** In each of the following questions, four alternatives are given, out of which three are alike in a certain way while one is different. Choose the odd one.

- (1) Rose
- (2) Lotus
- (3) Marigold
- (4) Lily

4) **Direction :** In each of the following questions, four alternatives are given, out of which three are alike in a certain way while one is different. Choose the odd one.

- (1) 9611
- (2) 7324
- (3) 2690
- (4) 1754

5) Which one of the numbers will complete the series ?

8, 13, 10, 15, 12, 17, 14 ... ?

- (1) 19
- (2) 22
- (3) 16
- (4) 20

6) Find the next term of series :

D I L Q T Y B G ?

- (1) H
- (2) I
- (3) J
- (4) P

7) **Direction :** In the following question, one term in the number series is wrong. Find out the wrong term.

1, 2, 4, 8, 16, 32, 64, 96

- (1) 4
- (2) 32
- (3) 64
- (4) 96

8) **Directions :** Find the missing character in each of the following questions.

1	12	10
15	2	?
8	5	3

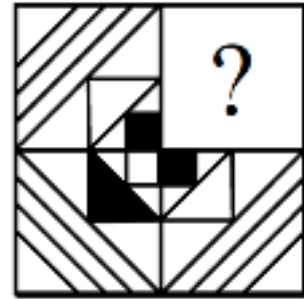
- (1) 9
- (2) 11
- (3) 4
- (4) 6

9) **Directions :** Find the missing character in each of the following questions.

6	9	15
8	12	20
4	6	?

- (1) 5
- (2) 10
- (3) 15
- (4) 21

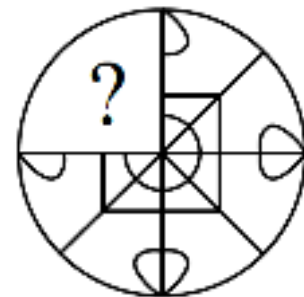
10) **Direction :** In each of the following questions, a part of the figure is missing. Find out from the



given options (1, 2, 3 and 4) the right figure to fit in the missing place.

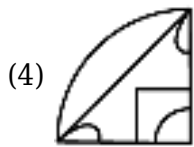
- (1)
- (2)
- (3)
- (4)

11) **Direction :** In each of the following questions, a part of the figure is missing. Find out from the

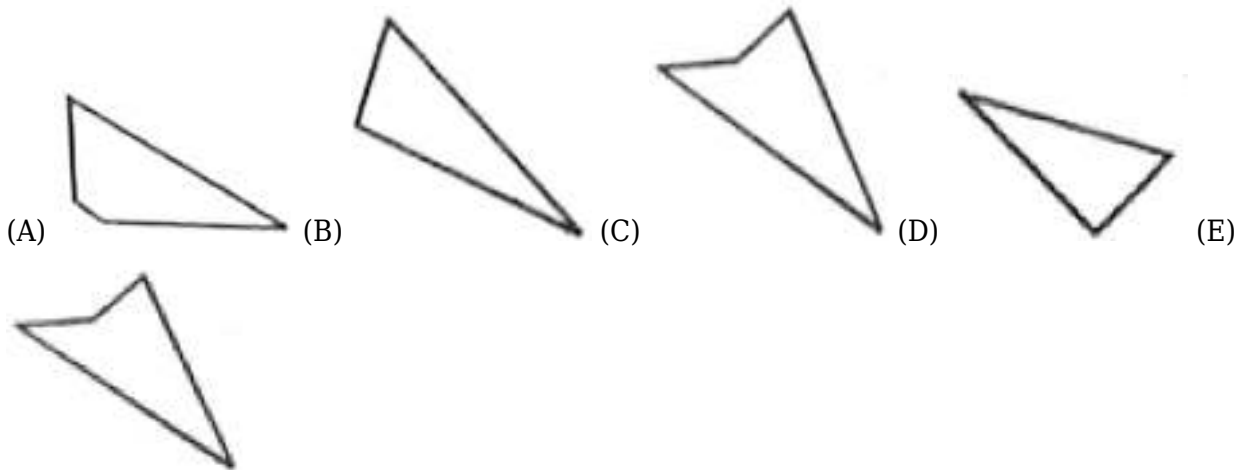


given options (1, 2, 3 and 4) the right figure to fit in the missing place.

- (1)
- (2)
- (3)

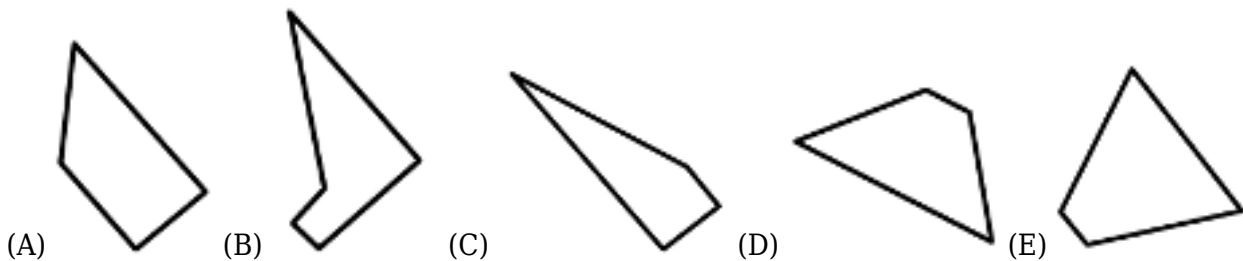


12) **Direction :** In the following question, select that combination of parts (A), (B), (C), (D) and (E) which if fitted together will form an equilateral triangle.



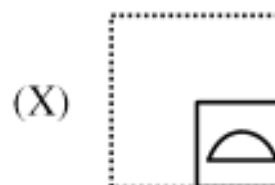
- (1) ABE
- (2) BCE
- (3) ADE
- (4) BDE

13) **Direction :** In the following question, select that combination of parts (A), (B), (C), (D) and (E) which if fitted together will form a square.

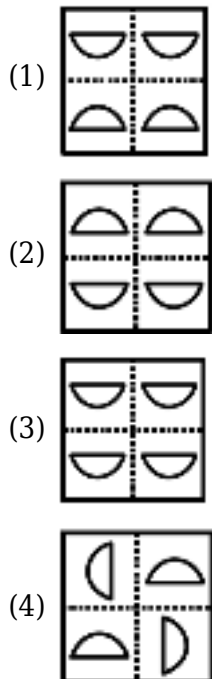


- (1) ABD
- (2) BCE
- (3) ACD
- (4) BDE

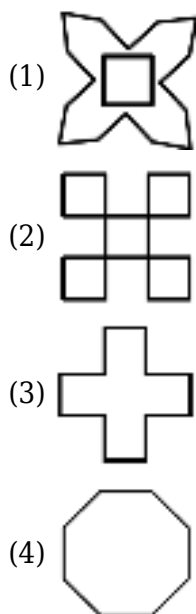
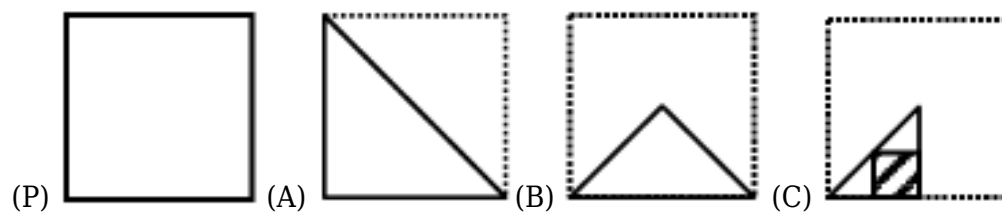
14) **Direction :** If a square sheet of paper is folded two times from the centre and cuts are made as shown in the problem figure how will it appear when it is opened ? Select the appropriate figure



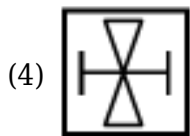
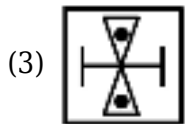
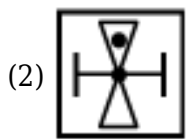
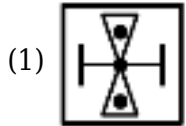
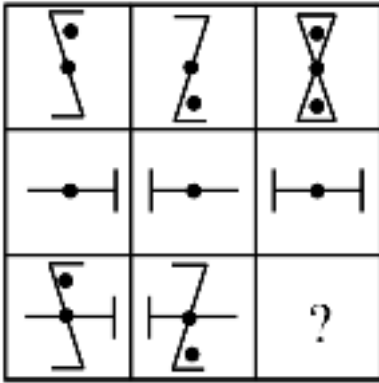
from the answer choices marked (1), (2), (3) and (4).



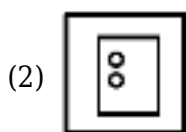
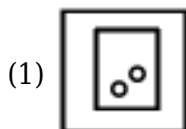
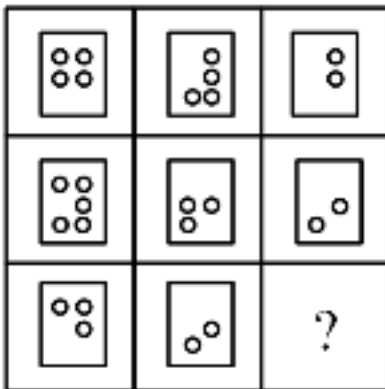
15) **Direction :** In the following question, a set of three figures A, B and C showing a sequence of folding of a piece of paper. Fig. (C) shows the manner in which the folded paper has been cut. These three figures are followed by four answer figures from which you have to choose a figure which would most closely resemble the unfolded form of fig, (C).

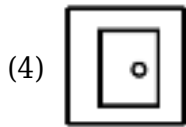
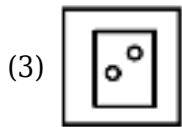


16) **Direction :** In each of the following questions, select the answer figure that will fit in the blank space in the question figure, maintaining the pattern in the proper sequence.



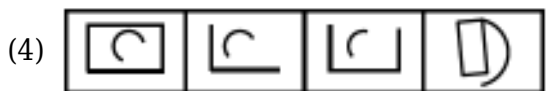
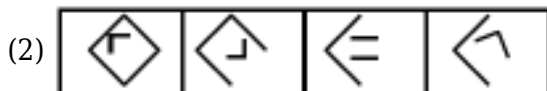
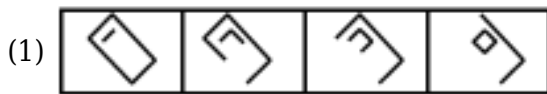
17) **Direction :** In each of the following questions, select the answer figure that will fit in the blank space in the question figure, maintaining the pattern in the proper sequence.





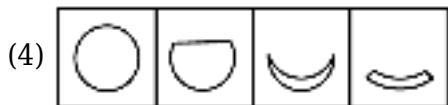
18) **Direction :** In the following question, contains four rows of figures. As four alternatives. Each row contains four of five different designs. You have to study carefully each row and judge which series of figures follows the stated rule exactly.

Rule : The number of sides decreases in closed figures and the number of sides increases in open figures.



19) **Direction :** In the following question, contains four rows of figures. As four alternatives. Each row contains four of five different designs. You have to study carefully each row and judge which series of figures follows the stated rule exactly.

Rule : Closed figure becomes more and more open.



20) **Direction :** Read the following information to answer the given question. Following are the criteria for selecting a marketing officer by a company. The candidate must

- (A) be a graduate with at least 50% marks.
- (B) have secured at least 40% marks in the written test.
- (C) not be less than 24 years and not more than 29 years as on 10th December, 1996.

(D) should have work experience of at least two years as a Marketing officer.

However, if a candidate :

(I) Fulfils all other criteria except at D above, but has a diploma in Marketing Management, his/her case is to be referred to General Manager, Marketing.

(II) Fulfils all other criteria except at C above, but has worked as Marketing officer at least for three years, his/her case is to be referred to Director, Marketing.

Based on the above criteria and the information given in each of the following questions, you have to take the decision in regard to each case. You are not to assume anything. These cases are given to you as on 10th December, 1996. Mark your answer as :

Sudha Mirchandani is a 1st class graduate and has secured 50% marks in the written test. She was 23 years old as on 5th November 1995. She has done a diploma in Marketing Management.

(1) if the candidate is to be appointed

(2) if the candidate is not to be appointed

(3) if the case is to be referred to General Manager, Marketing

(4) if the case is to be referred to Director, Marketing

MATHEMATICS

1) The set $(A \cap B')' \cup (B \cap C)$ is equal to

(1) $A' \cup B \cup C$

(2) $A' \cup B$

(3) $A' \cup C'$

(4) $A' \cap B$

2) A, B, C are three sets such that $n(A) = 25$, $n(B) = 20$, $n(C) = 27$, $n(A \cap B) = 5$, $n(B \cap C) = 7$, $n(A \cap C) = 0$ then $n(A \cup B \cup C)$ is equal to

(1) 60

(2) 65

(3) 67

(4) 72

3) If equations $x^3 + 2x^2 + 5x + m = 0$ and $x^3 + 2x^2 + 3x + n = 0$ has exactly one common root and product of their uncommon roots is -1, then value of $m + n$ is -

(1) 0

(2) 1

(3) -1

(4) 2

4) Let $S = \frac{4}{19} + \frac{44}{19^2} + \frac{444}{19^3} + \dots$ upto ∞ . Then S is equal to :-

(1) 38/81

- (2) $4/19$
- (3) $36/171$
- (4) None of these

5) The 5th & 8th term of GP are 7! and 8! respectively. If the sum of n terms is 2205 then n is equal to

- (1) 1
- (2) 2
- (3) 3
- (4) 4

6) $\cos(\alpha - \beta) = 1$ and $\cos(\alpha + \beta) = 1/e$, where $\alpha, \beta \in [-\pi, \pi]$. Number of pairs of (α, β) which satisfy both the equations is :-

- (1) 0
- (2) 4
- (3) 6
- (4) 7

7) If $\pi < \alpha < \frac{3\pi}{2}$, then the expression $\sqrt{(4\sin^4 \alpha + \sin^2 2\alpha) + 4\cos^2 \left(\frac{\pi}{4} - \frac{\alpha}{2}\right)}$ equals :-

- (1) $2 + 4\sin \alpha$
- (2) $2 - 4\sin \alpha$
- (3) 2
- (4) 0

8)
$$\begin{vmatrix} x & x+2y & x+3y \\ x+2y & x+4y & x+5y \\ x+4y & x+6y & x+7y \end{vmatrix} = \dots\dots$$

- (1) $3x + 5y$
- (2) $2y$
- (3) 0
- (4) 1

9)

The straight line $x = a$ and $x^2 - 3y^2 = 0$ encloses a triangle which is-

- (1) isosceles
- (2) right angled
- (3) equilateral

(4) None of these

10) The equation of the smallest circle passing through the intersection of the line $x + y = 1$ and the circle $x^2 + y^2 = 9$ is -

(1) $x^2 + y^2 + x + y - 8 = 0$

(2) $x^2 + y^2 - x - y - 8 = 0$

(3) $x^2 + y^2 - x + y - 8 = 0$

(4) none of these

11) If $a \neq 0$ and the line $2bx + 3cy + 4d = 0$ passes through the points of intersection of the parabolas $y^2 = 4ax$ and $x^2 = 4ay$, then

(1) $d^2 + (2b + 3c)^2 = 0$

(2) $d^2 + (3b + 2c)^2 = 0$

(3) $d^2 + (2b - 3c)^2 = 0$

(4) $d^2 + (3b - 2c)^2 = 0$

12) Consider the parabola with vertex $\left(\frac{1}{2}, \frac{3}{4}\right)$ and the directrix $y = \frac{1}{2}$. Let P be the point where the parabola meets the line $x = -\frac{1}{2}$. If the normal to the parabola at P intersects the parabola again at the point Q, then $(PQ)^2$ is equal to :

(1) $\frac{75}{8}$

(2) $\frac{125}{16}$

(3) $\frac{25}{2}$

(4) $\frac{15}{2}$

13) The locus of point of intersection of two perpendicular tangent of the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ is :-

(1) $x^2 + y^2 = 4$

(2) $x^2 + y^2 = 9$

(3) $x^2 + y^2 = 13$

(4) $x^2 + y^2 = 5$

14) The locus of the middle points of chords of hyperbola $3x^2 - 2y^2 + 4x - 6y = 0$, parallel to $y = 2x$ is

(1) $3x - 4y = 4$

(2) $3y - 4x + 4 = 0$

(3) $4x - 4y = 3$

(4) $3x - 4y = 2$

15) If $(1 + x)^n = \sum_{r=0}^n C_r x^r$, then
 $\left(1 + \frac{C_1}{C_0}\right)\left(1 + \frac{C_2}{C_1}\right)\left(1 + \frac{C_3}{C_2}\right) \dots \left(1 + \frac{C_n}{C_{n-1}}\right) =$

(1) $\frac{n^{n-1}}{n!}$

(2) $\frac{(n-1)^n}{(n-1)!}$

(3) $\frac{n^{n-1}}{(n-1)!}$

(4) $\frac{(n+1)^n}{n!}$

16) The number of distinct term in the expansion of $(x + y^2)^{13} + (x^2 + y)^{14}$ is :-

(1) 27

(2) 28

(3) 29

(4) 25

17) Consider 4 boxes, where each box contains 3 red balls and 2 blue balls. Assume that all 20 balls are distinct. In how many different ways can 10 balls be chosen from these 4 boxes so that from each box at least one red ball and one blue ball are chosen ?

(1) 85536

(2) 21816

(3) 12096

(4) 156816

18) If $f : \mathbb{R} \rightarrow \mathbb{R}$, $f(x) = x^3 + 3$ then the value $g : \mathbb{R} \rightarrow \mathbb{R}$, $g(x) = 2x + 1$ of $(f^{-1} \circ g^{-1})(23)$ is equal to

(1) 2

(2) 4

(3) 8

(4) 16

19) If $y = 2[x] + 3$ and $y = 3[x - 2] + 5$ then $[x + y]$ is equal :- (where $[.]$ is GIF)

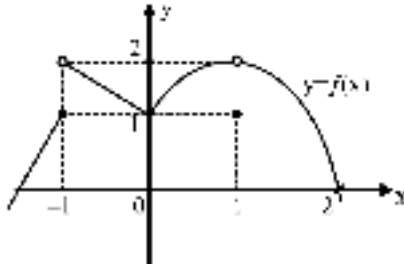
(1) 10

(2) 15

(3) 20

(4) 25

20) The graph of function $y = f(x)$ is shown below.



The value of $\lim_{x \rightarrow 1} f(-|x|)$

- (1) 0
- (2) 1
- (3) 2
- (4) does not exist

21) Let $f(x)$ be twice differentiable function and $f'(0) = 5$, then $\lim_{x \rightarrow 0} \frac{3f(x) - 4f(3x) + f(9x)}{x^2}$ is equal to

- (1) 30
- (2) 120
- (3) 40
- (4) -120

22) If $f(x) = \begin{cases} a\sqrt{x+1}, & 0 < x < 3 \\ bx+2, & 3 \leq x < 5 \end{cases}$ is differentiable in $(0, 5)$ then $(a + b)$ is

- (1) 2
- (2) 3
- (3) 8
- (4) 9

23) For $a > 0$, $t \in \left(0, \frac{\pi}{2}\right)$, let $x = \sqrt{a \sin^{-1} t}$ and $y = \sqrt{a \cos^{-1} t}$. Then, $1 + \left(\frac{dy}{dx}\right)^2$ equals

- (1) $\frac{y^2}{x^2}$
- (2) $\frac{x^2 + y^2}{x^2}$
- (3) $\frac{x^2}{y^2}$
- (4) $\frac{x^2 + y^2}{y^2}$

24) $\int \sqrt{1+x} \sqrt{1+(x+1)} \sqrt{1+(x+2)(x+4)} dx =$

(1) $\frac{x^2}{2} + x + C$

(2) $\frac{x^2}{2} - x + C$

(3) $\frac{x^2}{2} + C$

(4) $x + C$

25) If $I_1 = \int_0^1 2^{x^2} dx$, $I_2 = \int_0^1 2^{x^3} dx$, $I_3 = \int_1^2 2^{x^2} dx$ and $I_4 = \int_1^2 2^{x^3} dx$ then

(1) $I_3 > I_4$

(2) $I_3 = I_4$

(3) $I_1 > I_2$

(4) $I_2 > I_1$

26) $\lim_{n \rightarrow \infty} \left(\frac{(n+1)^{1/3}}{n^{4/3}} + \frac{(n+2)^{1/3}}{n^{4/3}} + \dots + \frac{(2n)^{1/3}}{n^{4/3}} \right)$ is equal to:

(1) $\frac{4}{3}(2)^{4/3}$

(2) $\frac{3}{4}(2)^{4/3} - \frac{4}{3}$

(3) $\frac{3}{4}(2)^{4/3} - \frac{3}{4}$

(4) $\frac{4}{3}(2)^{3/4}$

27) The area of the region $\{(x, y) : |x - y| \leq y \leq 4\sqrt{x}\}$ is

(1) 512

(2) $\frac{1024}{3}$

(3) $\frac{512}{3}$

(4) $\frac{2048}{3}$

28) $\frac{dy}{dx} = (x^3 - 2x \sin^{-1}y) \sqrt{1 - y^2}$
General solution will be

(1) $2 \sin^{-1}y = (x^2 - 1) + C e^{-x^2}$

(2) $2 \cos^{-1}y = (x^4 + 1) + C$

(3) $e^{x^2} \sin^{-1}y = (x^2 - x) + C$

(4) $2\cos^{-1}y = (x^2 - 1)e^{-x^2} + C$

29) If $A_\lambda = \begin{bmatrix} \lambda & \lambda-1 \\ \lambda-1 & \lambda \end{bmatrix}$; $\lambda \in \mathbb{N}$ then $|A_1| + |A_2| + \dots + |A_{300}|$ is equal to :-

- (1) $(299)^2$
- (2) $(300)^2$
- (3) $(301)^2$
- (4) None of these

30) If $A = \begin{bmatrix} 0 & c & -b \\ -c & 0 & a \\ b & -a & 0 \end{bmatrix}$ and $B = \begin{bmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ac & bc & c^2 \end{bmatrix}$ then $(A + B)^2 = ?$:-

- (1) A
- (2) B
- (3) I
- (4) $A^2 + B^2$

31) Let $\vec{u} = \hat{i} - \hat{j} - 2\hat{k}$, $\vec{v} = 2\hat{i} + \hat{j} - \hat{k}$, $\vec{v} \cdot \vec{w} = 2$ and $\vec{v} \times \vec{w} = \vec{u} + \lambda \vec{v}$. Then $\vec{u} \cdot \vec{w}$ is equal to

- (1) 1
- (2) $\frac{3}{2}$
- (3) 2
- (4) $-\frac{2}{3}$

32)

If $\vec{r} = x(\vec{a} \times \vec{b}) + y(\vec{b} \times \vec{c}) + z(\vec{c} \times \vec{a})$ and $[\vec{a} \ \vec{b} \ \vec{c}] = \frac{1}{3}$, then $x + y + z$ is equal to

- (1) $7\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$
- (2) $\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$
- (3) $5\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$
- (4) $3\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$

33) Projection of the line segment joining the points $(-1, 0, 3)$ and $(2, 5, 1)$ on the line whose Dr's are 6, 2, 3 :-

- (1) $\frac{7}{22}$

- (2) $\frac{22}{7}$
 (3) $\frac{11}{7}$
 (4) $\frac{7}{11}$

34) Let the plane $2x + 3y + z + 20 = 0$ be rotated through a right angle about its line of intersection with the plane $x - 3y + 5z = 8$. If the mirror image of the point $\left(2, -\frac{1}{2}, 2\right)$ in the rotated plane is $B(a, b, c)$, then :

- (1) $\frac{a}{8} = \frac{b}{5} = \frac{c}{-4}$
 (2) $\frac{a}{4} = \frac{b}{5} = \frac{c}{-2}$
 (3) $\frac{a}{8} = \frac{b}{-5} = \frac{c}{4}$
 (4) $\frac{a}{4} = \frac{b}{5} = \frac{c}{2}$

35) If $|z_1| = |z_2| = \dots\dots\dots = |z_n| = 1$, then the value of $|z_1 + z_2 + z_3 + \dots\dots\dots + z_n|$ is :-

- (1) 1
 (2) $|z_1| + |z_2| + \dots\dots + |z_n|$
 (3) $\left| \frac{1}{z_1} + \frac{1}{z_2} + \dots\dots + \frac{1}{z_n} \right|$
 (4) None of these

36) Let z, w be complex numbers such that $\bar{z} + i\bar{w} = 0$ and $\arg(zw) = \pi$; Then $\arg(z)$ is equal to :-

- (1) $\frac{\pi}{4}$
 (2) $\frac{\pi}{2}$
 (3) $\frac{3\pi}{4}$
 (4) $\frac{5\pi}{4}$

37) The probability that the birthdays of six different persons will fall in exactly two calendar months

- (1) $\frac{342}{12^5}$
 (2) $\frac{341}{12^6}$
 (3) $\frac{341}{12^5}$

(4) $\frac{342}{12^6}$

38) A student appears for a quiz consisting of only true-false type questions and answers all the questions. The student knows the answers of some questions and guesses the answers for the remaining questions. Whenever the student knows the answer of a question, he gives the correct answer. Assume that the probability of the student giving the correct answer for a question, given that he has guessed it, is $\frac{1}{2}$. Also assume that the probability of the answer for a question being guessed, given that the student's answer is correct, is $\frac{1}{6}$. Then the probability that the student knows the answer of a randomly chosen question is :

(1) $\frac{1}{12}$

(2) $\frac{1}{7}$

(3) $\frac{5}{7}$

(4) $\frac{5}{12}$

39) The mean of 100 items is 50 and their S.D. is 4. The sum of all the items and also the sum of the squares of the items is :-

(1) 5000, 251600

(2) 4000, 251600

(3) 5000, 261600

(4) None of these

40) If $x = \sin (2 \tan^{-1} 2)$, $y = \sin \left(\frac{1}{2} \tan^{-1} \frac{4}{3} \right)$, then -

(1) $x = 1 - y$

(2) $x^2 = 1 - y$

(3) $x^2 = 1 + y$

(4) $y^2 = 1 - x$

ANSWER KEYS

PHYSICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	1	1	3	3	4	2	3	3	2	4	3	2	1	3	3	3	1	3	4	2
Q.	21	22	23	24	25	26	27	28	29	30										
A.	2	2	4	2	4	2	1	1	1	2										

CHEMISTRY

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	3	2	4	3	4	3	4	3	3	2	1	4	3	4	2	1	1	1	3	3
Q.	51	52	53	54	55	56	57	58	59	60										
A.	3	2	1	3	1	2	3	2	4	4										

ENGLISH PROFICIENCY

Q.	61	62	63	64	65	66	67	68	69	70
A.	2	3	3	3	2	1	2	2	2	2

LOGICAL REASONING

Q.	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
A.	1	2	2	2	1	2	4	3	2	1	1	3	2	1	2	1	4	1	1	4

MATHEMATICS

Q.	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110
A.	2	1	1	1	3	2	3	3	3	2	1	2	3	1	4	2	2	1	2	4
Q.	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
A.	2	1	2	1	3	3	2	1	2	4	1	4	2	1	3	3	3	3	1	4

SOLUTIONS

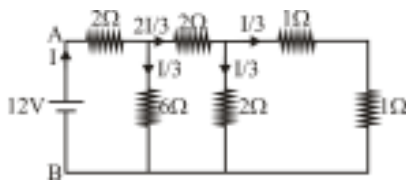
PHYSICS

1)

Explain Question : To find current as shown in figure.

Concept : This question is based on voltage and currents in simple circuit.

Solution :



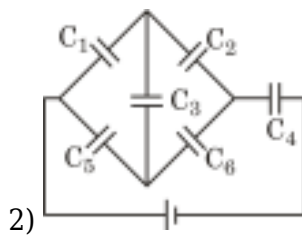
The equivalent resistance between A and B = 4Ω .

$$\text{Current } I = \frac{12V}{4\Omega} = 3A$$

The current divides into different branches as shown in the figure. It is clear that the ammeter will

read $\frac{I}{3} = \frac{3A}{3} = 1A$. So the correct choice is (1)

Final Answer : option (1)



2)

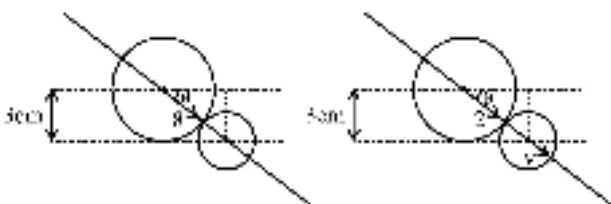
Initially $Q_i = \frac{CV}{4}$

Finally $Q_f = \frac{CV}{3}$

$$Q_i : Q_f = 3 : 4$$

3) By circuit analysis,

R_{eq} in letter C is maximum.



4)

From figure

$$\sin \theta = \frac{3}{5}$$

$$\theta = 37^\circ$$

by momentum conservation along the line of impact.

$$3 \times 8 = 3 \times 2 + 2 \times v$$

$$v = 9$$

$$e = \frac{v_2 - v_1}{u_1 - u_2} = \frac{9 - 2}{8 - 0} = \frac{7}{8}$$

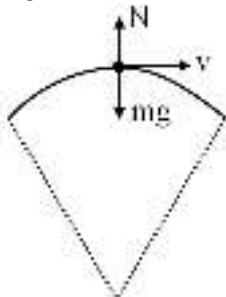
5) **Explain question :** The problem is about the normal contact force between motorcycle and bridge (in the form of circular arc) at the highest form.

Concept : This question is based on dynamics of circular motion.

Solution :

Required centripetal force equation is given by

$$mg - N = \frac{mv^2}{r}$$



□ Normal contact force (N)

$$= mg - \frac{mv^2}{r}$$

Final answer : 4

$$6) T_s = 3mg$$

$$\frac{3mg}{A_s} = y_s \times \frac{\Delta \ell_s}{\ell_s}$$

$$\frac{2mg}{A_b} = y_b \times \frac{\Delta \ell_b \Delta \ell_b}{\ell_b \ell_b}$$

$$\frac{\Delta \ell_s}{\Delta \ell_b} = \frac{3}{2} \times \frac{\ell_s}{\ell_b} \times \frac{A_b}{A_s} \times \frac{y_b}{y_s} = \frac{3}{2} \times \frac{a}{b^2 c}$$

$$7) mg(L - L \cos \alpha) = \frac{1}{2}mv^2$$

$$v^2 = 0.1 \times 10 = v = 1 \text{ m/s}$$

$$\varepsilon = B\ell v$$

8)

Power in ac circuit is $p = VI \cos \phi$

Where ϕ is angle between v and I

Voltage is denoted by E in given question

$$V = E = E_0 \sin \omega t$$

$$I = I_0 \sin \left(\omega t - \frac{\pi}{2} \right)$$

angle or phase difg between V and I = $\pi/2$

$$p = VI \cos \frac{\pi}{2}$$

$$P = 0$$

$$11) \vec{E}_p = 0$$

$$\vec{E}_q + \vec{E}_{q0} + \vec{E}_{\text{induced}} = 0$$

$$E_{\text{induced}} = -(\vec{E}_q + \vec{E}_{q0})$$

$$= \left[-\frac{kq}{a^2} \hat{i} + \frac{kq_0}{r^2} [\hat{j}] \right]$$

12)

Explanation Question: A u-tube contains glycerin, mercury and oil in such a way that both arms have same top level. We need to find length of oil column

Concept: This question is based on pascal's law

Solution:

$$P_0 + \rho_{gl} g \times 20 = P_0 + \rho_{gl} g h + \rho_{Hg} g \times (20 - h)$$

$$h = 19.2 \text{ cm}$$

$$P_0 + \rho_{gl} g \times 10 = P_0 + \rho_{oil} g \times h$$

$$+ \rho_{Hg} g \times (10 - h)$$

$$h = 19.2 \text{ cm}$$

Final Answer

The correct option is (2)

14) Lenses are of opposite nature, so,

$$\frac{1}{f_1} = \left(\frac{\mu_1}{\mu_w} - 1 \right) \left(\frac{2}{R} \right)$$

$$\frac{1}{f_2} = \left(\frac{\mu_2}{\mu_w} - 1 \right) \left(-\frac{2}{R} \right)$$

focal length of the system is

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\frac{1}{24} = \left(\frac{\mu_1}{\mu_w} - \frac{\mu_2}{\mu_w} \right) \left(\frac{2}{R} \right)$$

$$= \left(\frac{\mu_1 - \mu_2}{\mu_w} \right) \left(\frac{2}{20} \right)$$

$$\text{So, } (\mu_1 - \mu_2) = \frac{5}{9}$$

$$15) \text{ } \begin{array}{c} m \bullet \text{---} \bullet \text{---} \bullet 3m \\ \text{---} 3r/4 \text{---} \end{array} \quad \frac{Gm3m}{r^2} = m \left(\frac{3r}{4} \right) \omega^2 \Rightarrow \omega = \sqrt{\frac{4GM}{r^3}}$$

$$\begin{aligned}
 16) \quad \left. \frac{dm}{dt} \right|_{\text{Steam}} &= \frac{1}{16} \left. \frac{dm}{dt} \right|_{\text{ice}} \\
 \left. \frac{dQ}{dt} \right|_{\text{Steam}} &= \frac{T-100}{\left(\frac{2\ell}{3Ak}\right)} = \left(\frac{dm}{dt} \right)_{\text{steam}} L_v \\
 \left. \frac{dQ}{dt} \right|_{\text{Ice}} &= \frac{T-0}{\left(\frac{\ell}{3Ak}\right)} = 16 \left(\frac{dm}{dt} \right)_{\text{steam}} L_f \\
 \frac{T-100}{2} &= \frac{L_v}{16L_f} \\
 \frac{(T-100)}{2T} &= \frac{540}{16 \times 80} \\
 \frac{T-100}{2T} &= \frac{640}{540} \\
 \frac{T-100}{2T} &= \frac{8}{8 \times 80}
 \end{aligned}$$

17)

$$\begin{aligned}
 \eta &= \frac{\text{Work done}}{Q_{\text{in}}} \\
 W &= W_{AB} + W_{BC} + W_{CA} \\
 &= 0 + 2P_0V_0 \ln 2 - P_0V_0 \\
 Q_{\text{in}} &= Q_{AB} + Q_{BC} = \frac{3}{2} [P_0V_0] + 2P_0V_0 \ln 2 \\
 \eta &= \frac{2P_0V_0 \ln 2 - P_0V_0}{\frac{3}{2}P_0V_0 + 2P_0V_0 \ln 2} \\
 &\Rightarrow \frac{\ln 4 - 1}{\frac{3}{2} + \ln 4} \Rightarrow \frac{2\ln 4 - 2}{3 + 2\ln 4}
 \end{aligned}$$

18)

$$\begin{aligned}
 80 &= \frac{1}{2} \times 10 \times t^2 \Rightarrow t = 4 \text{ sec} \\
 10 \times 4 + v \times 4 &= 60 \Rightarrow v = 5 \text{ m/s}
 \end{aligned}$$

19)

$$\begin{aligned}
 H_{\text{max}} &= \text{Same} & v_{y1} &= v_{y2} \\
 & & T_1 &= T_2 \\
 \theta_1 &> \theta_2 \\
 v_1 \sin \theta_1 &= v_1 < v_2
 \end{aligned}$$

$$20) \quad r = 2R, \quad 5\mu T = \frac{\mu_0 I}{2\pi(2R)} \Rightarrow \frac{\mu_0 I}{\pi R} = 20\mu T$$

$$B = \frac{\mu_0 I r}{2\pi R^2} = \frac{\mu_0 I \left(\frac{2R}{3}\right)}{2\pi R^2} = \frac{\mu_0 I}{3\pi R}$$

$$= \frac{1}{3} \times 20 \mu T$$

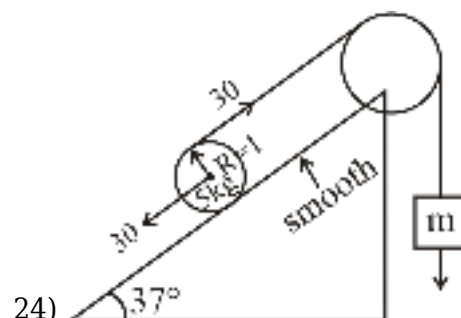
$$= \frac{20}{3} \mu T$$

21) 
 $B_D = 6(B_{AB} - B_{CD})$

Final answer: Option(2)

$$23) \lambda = \frac{h}{\sqrt{2mE}}$$

$$\lambda' = \frac{h}{\sqrt{2m(E-V)}}$$



$$T = mg \sin \theta; T = 30$$

$$a = 6 \text{ rad/sec}^2$$

acceleration of block is 6

$$10m - T = 6m$$

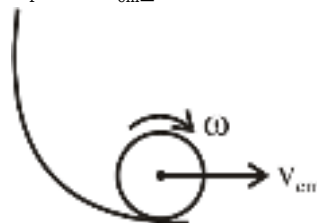
$$m = 7.5$$

25) **Explanation :** We are given, a sphere attached by a light rod and it rolls without slipping on a circular track as shown. Calculate the angular momentum of the system about P when the rod becomes vertical.

Concept : Energy conservation and angular momentum about a point.

Solution :

$$L_P = mv_{cm} \ell - \frac{2}{5} mR^2 \omega$$



$$= mv_{cm} \ell - \frac{2}{5} mRv_{cm} = mv_{cm} \left(\ell - \frac{2}{5} R \right)$$

$$mg\ell = \frac{1}{2} mv_{cm}^2 + \frac{1}{2} \frac{2}{5} mR^2 \omega^2 \Rightarrow \frac{7}{10} mv_{cm}^2$$

$$\therefore v_{cm} = \sqrt{\frac{10}{7} g \ell}$$

Final answer : Option (4) is the correct answer.

26) **Question Explanation:** Calculate the value of the series resistor R_s for a Zener regulated power supply given voltages and currents.

Concept: Zener diode

Solution:

Total current = (4 + 20)mA

voltage across load = 6 volt

voltage across $R_s = 10 - 6 = 4V$

This gives $R_s = 4.0 V / (24 \times 10^{-3}) A = 167 \Omega$.

Final Answer : Option (2)

27) **Explanation:** In this question two blocks connected with spring are placed one over the other, both blocks moving without slipping it is asked to find time period of oscillation.

Concept: Time period of SHM

Solution:

Both springs are in series

Parallel $k_{eq} = k + 2k = 3k$

Total mass $= 2m + m = 3m$

$$T = 2\pi \sqrt{\frac{3m}{3k}} = 2\pi \sqrt{\frac{m}{k}}$$

Final Answer: Time period of oscillation is $2\pi \sqrt{\frac{m}{k}}$ option (1)

28) **Question Explanation:** Find the speed of a wave from its equation.

Concept: Wave Parameters

Solution: A traveling wave is described by the equation $y(x,t) = A \sin(\omega t - kx + \phi)$. The wave speed is the ratio of the angular frequency (ω) to the wave number (k).

Calculation: The given wave equation is $y = 7 \sin$

$$v = \frac{\omega}{k} = \frac{7\pi}{0.04\pi} = \frac{700}{4} = 175 \text{ m/s}$$
$$\left(7\pi t - 0.04\pi x + \frac{\pi}{3} \right).$$

By comparing this to the standard form $y = A \sin(\omega t - kx + \phi)$, we can identify the angular frequency and wave number.

Angular frequency $\omega = 7\pi \text{ rad/s}$. Wave number $k = 0.04\pi \text{ rad/m}$.

The speed of the wave is v

$$= \frac{\omega}{k} = \frac{7\pi}{0.04\pi} = \frac{7}{0.04} = \frac{700}{4} = 175 \text{ m/s}.$$

$$29) \Delta\phi = \frac{2\pi}{\lambda} \Delta x \quad \& \quad \Delta x = \left(\frac{y}{D} \right) \times d$$

$$y_1 = \frac{3\lambda D_1}{d}$$

Now for y_2

$$I_{\max} \cos^2 \frac{\Delta\phi}{2} = I_{\max} \times \frac{3}{4} \Rightarrow \Delta\phi = \frac{\pi}{3} + 2n\pi$$

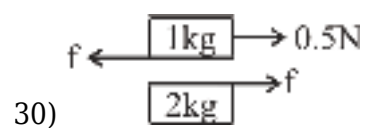
$$\& \text{ this can be } 4\pi + \frac{\pi}{3} \text{ or } 6\pi - \frac{\pi}{3} \quad 6\pi - \frac{\pi}{3}$$

$$\Rightarrow \left(\frac{y_2}{D_2} \times d \right) \frac{2\pi}{\lambda} = \Delta\phi \Rightarrow y_2 = \frac{17D_2\lambda}{6d}, \frac{13D_2\lambda}{6d}$$

$$\square y_1 = y_2 \Rightarrow \frac{13D_2}{6} = 3D_1$$

$$\text{finally } D_2 = \frac{18}{13} D_1$$

$$v = \frac{D_2 - D_1}{\Delta t} = \frac{5D}{13}$$



$$0.5 = 3a \Rightarrow a = 5/30$$

$$f = 2a = 2(5/30) = 1/3 \text{ N}$$

$$f_{\max} = 0.1 \times 10 = 10 \text{ N}$$

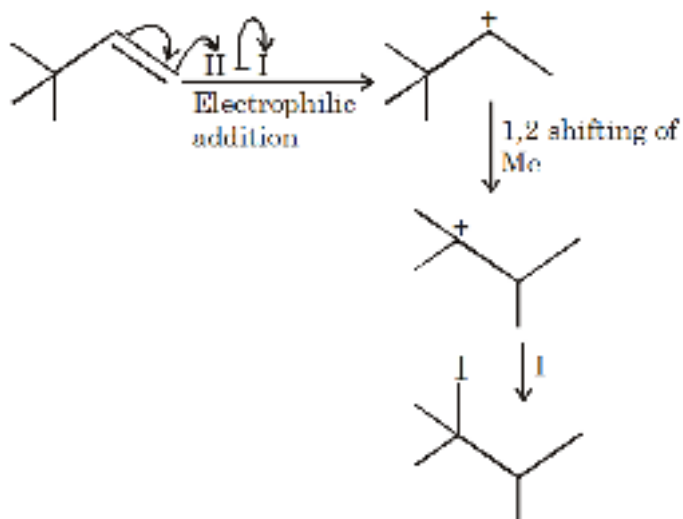
□ $f = 1/3 \text{ N}$ will act

work done by lower block

$$= -f(s)$$

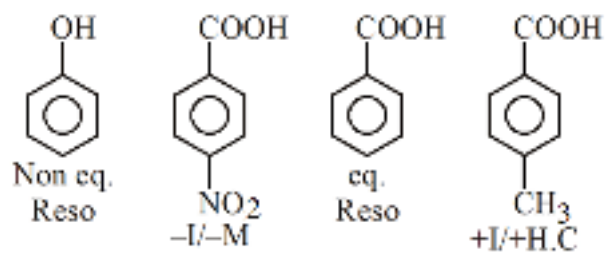
$$= -1/3(3) = -1 \text{ Joule}$$

CHEMISTRY



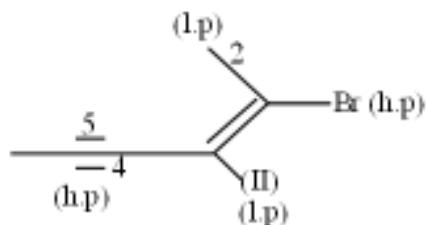
31)

- 32) (a) Valium - Tranquilizer (a)-(iv)
 (b) Morphine - Analgesic (b)-(iii)
 (c) Norethindrone - Antifertility Drug (c)-(i)
 (d) Vitamin B₁₂ - Pernicious anaemia (d)-(ii)



33)

$$2 > 3 > 4 > 1$$

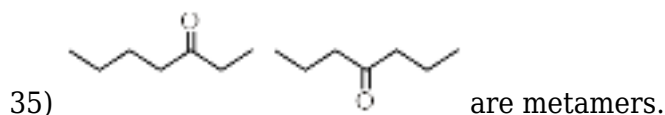


h.p. $\Rightarrow$ higher priority

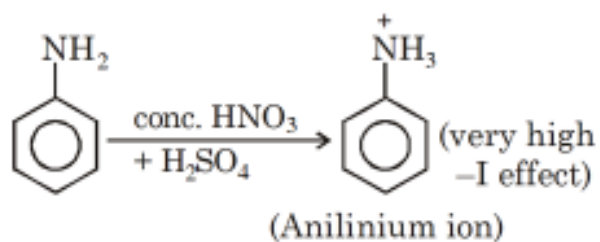
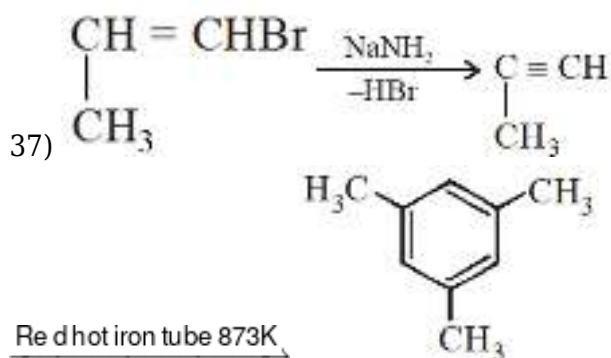
l.p. $\Rightarrow$ lower priority

34)

2E -2- bromo hex -2- en-4-yne



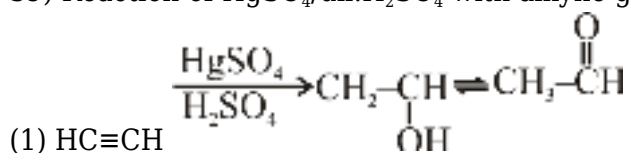
36) Alkane are very less reactive, tertiary hydrogen can oxidise to alcohol with KMnO_4 .

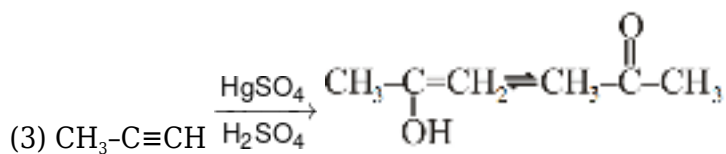
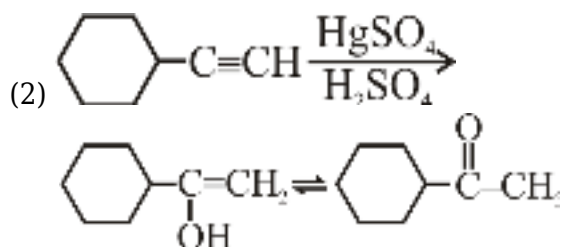


38)

Aniline on protonation gives anilinium ion which is meta directing. So considerable amount of meta product is formed.

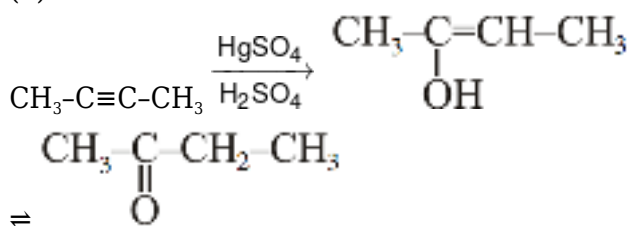
39) Reaction of $\text{HgSO}_4/\text{dil. H}_2\text{SO}_4$ with alkyne gives addition of water as per markonikoff's rule.



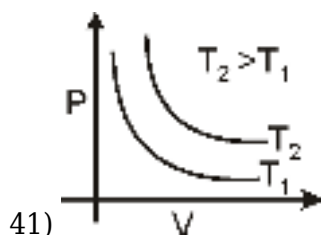
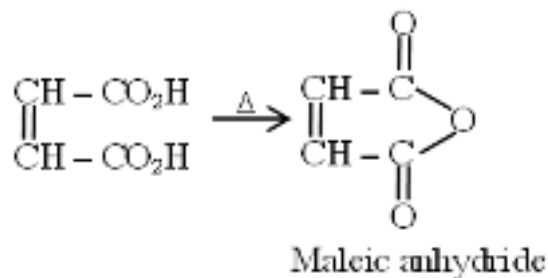


Hence $\text{CH}_3\text{-CH}_2\text{-CHO}$ cannot be form.

(4)



40) Cis but 2-enoic acid



42)

Above critical temperature gases can not be liquified whatever the pressures applied. Below the critical temperature (T_c) gases can be liquified.

43)

$\text{M}^{+3} \rightarrow \text{M}^{+n}$ (Reduction)

n-factor = $(3 - n) e^-$ gain

$\text{SO}_3^{-2} \rightarrow \text{SO}_4^{-2}$ (oxidation)

n-factor = $(+4 \text{ to } +6)$

= $2e^-$ loss

Total loss = Total gain

$$0.1 \text{ M} \times (3 - n) \times 50 \text{ ml} = 0.1 \text{ M} \times (2) \times 25 \text{ ml}$$

$$3 - n = 1$$

$$n = 2$$

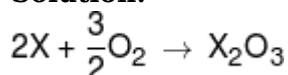
44) Question Explanation:

Question is asking about atomic weight of X.

Concept:

This question is based on stoichiometry.

Solution:



Apply POAC on X

$$\text{moles of X} = 2 \times \text{moles of } X_2O_3$$

$$\frac{1}{M} = \frac{2 \times 1.16}{2M + 48}$$

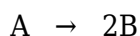
$$M = 150$$

Final Answer: The correct option is (4).

45)

(B) Higher is the coagulating power of an electrolyte, higher is its coagulation value.

47) For 1st order reaction



Initial conc. 0.8 -

After t = 1 min. 0.8 - 0.8x 1.6x [x dissociation]

It is given after 1 min. conc. of [B] = 1.6x = 0.8

$$x = 0.5$$

Hence Remaining conc. of [A] = 0.8 - 0.8 (0.5) = 0.4 M.

$$\text{For 1}^{\text{st}} \text{ order } t_{y_2} = \frac{0.693}{K}$$

$$K = \frac{2.303}{t} \log_{10} \left[\frac{R_0}{R} \right]$$

$$K = \frac{2.303}{60 \text{ sec}} \log_{10} \left[\frac{0.8}{0.4} \right]$$

$$K = \frac{0.693}{60}$$

$$t_{y_2} = \frac{0.693}{0.693} \times 60$$

$$t_{y_2} = 60 \text{ sec}$$

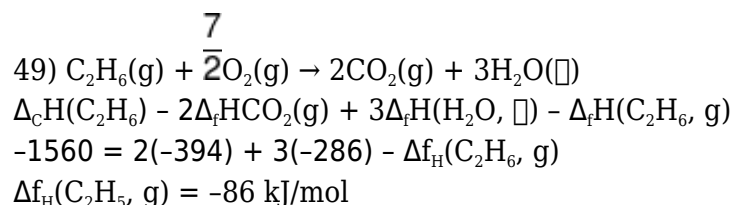
48)

$$r = k[\text{NOBr}_2][\text{NO}]$$

$$k_{eq} = \frac{k_1}{k_2} = \frac{[\text{NO Br}_2]}{[\text{NO}] [\text{Br}_2]}$$

$$[\text{NO Br}_2] = \frac{k_1}{k_2} [\text{NO}] [\text{Br}_2]$$

$$r = \frac{k k_1}{k_2} [\text{NO}] [\text{Br}_2] [\text{NO}] = k^1 [\text{NO}]^2 [\text{Br}_2]$$



50) **Explain Question :**

Which is isotonic with 15% $\frac{w}{w}$ glucose solution.

Concept :

Isotonic solution

Solution :

for glucose $i = 1$

$$\pi = iCRT$$

$$\pi_{\text{glucose}} = \frac{1 \times \frac{\%w/w \times 10 \times d}{M_w} RT}{15 \times 10 \times 1.2}$$

$$= 1 \times \frac{180}{180} \times RT$$

$$\pi_{\text{glucose}} = RT$$

isotonic solution i.e same osmotic pressure

$$0.5M \Rightarrow \pi_{\text{NaCl}} = iCRT = 2 \times 0.5 RT = RT$$

$$1N \Rightarrow \pi_{\text{CaCl}_2} = iCRT = 3 \times \frac{1}{2} RT = 1.5RT$$

$$1M \Rightarrow \pi_{\text{CaCl}_2} = iCRT = 3 \times 1 \times RT = 3RT$$

$$0.5 \Rightarrow \pi_{\text{urea}} = iCRT = 1 \times 0.5 RT = 0.5RT$$

Final Answer option (3)

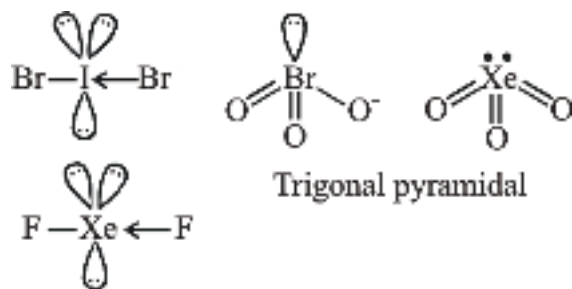
51)

I.E. : $\text{F}^- < \text{Cl}^-$

E.A. : $\text{O} < \text{Cl}$

ionic size : $\text{H}^- > \text{Cl}^-$

52) In Al_2Cl_6 hybridisation of Al is sp^3



53) Linear

54) $K_3[Cu(CN)_4]$ have no unpaired electron

55) **Solution:** Both Ag and Au are processed by this cyanide method.

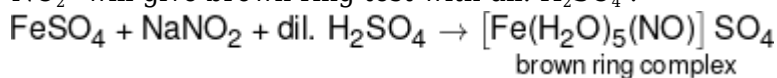
56) Solution Zr and Hf has nearly same radius due to lanthanide contraction.

57) $2CuCl_2 + SO_2 + 2H_2O \rightarrow Cu_2Cl_2 + H_2SO_4 + HCl$

x = SO_2 gas.

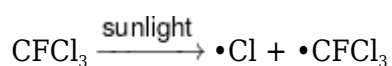
58)

$NO_2^\ominus$ will give brown ring test with dil. H_2SO_4 .



59) The purpose of adding gypsum is only to slow down the process of setting of cement

60)



ENGLISH PROFICIENCY

61) The correct answer is (2)

62) The correct answer is (3)

63) The correct answer is (3)

64) The correct answer is (3)

65) The correct answer is (2)

66) The correct answer is (1)

67) The correct answer is (2)

68) The correct Answer is (2)

69) The correct answer is (2)

70) The correct answer is (2)

LOGICAL REASONING

71) The correct answer is (1)

72) The correct answer is (2)

73) The correct answer is (2)

74) The correct answer is (2)

75) The correct answer is (1)

76) The correct answer is (2)

77) The correct answer is (4)

78) The correct answer is (3)

79) The correct answer is (2)

80) The correct answer is (1)

81) The correct answer is (1)

82) The correct answer is (3)

83) The correct answer is (2)

84) The correct answer is (1)

85) The correct answer is (2)

86) The correct answer is (1)

87) The correct answer is (4)

88) The correct answer is (1)

89) The correct answer is (1)

90) The correct answer is (4)

MATHEMATICS

91)

By Venn diagram it can be visualized.

$$92) \square n(A \cap C) = 0 \Rightarrow n(A \cap B \cap C) = 0$$

$$\text{Now } n(A \cup B \cup C) = n(A) + n(B) + n(C)$$

$$- n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$$

$$\Rightarrow n(A \cup B \cup C) = 25 + 20 + 27 - 5 - 7 - 0 + 0 \\ = 60$$

$$93) x^3 + 2x^2 + 5x + m = 0$$

$$x^3 + 2x^2 + 3x + n = 0$$

$$x = \frac{n-m}{2}$$

and product of un common roots

$$\frac{mn}{\left(\frac{n-m}{2}\right)^2} = -1$$

$$\Rightarrow m + n = 0$$

$$S = \frac{4}{19} + \frac{44}{19^2} + \frac{444}{19^3} + \dots$$

$$\frac{S}{19} = \frac{4}{19^2} + \frac{44}{19^3} + \frac{444}{19^4} + \dots$$

- - - - -

$$94) \frac{18S}{19} = \frac{4}{19} + \frac{40}{19^2} + \frac{400}{19^3} + \dots$$

$$\frac{18S}{19} = \frac{\frac{4}{19}}{1 - \frac{10}{19}} \Rightarrow S = \frac{4}{9} \times \frac{19}{18} = \frac{38}{81}$$

$$95) T_5 = 7! = ar^4$$

$$T_8 = 8! = ar^7$$

$$r^3 = 8 \Rightarrow r = 2$$

$$7! = a \cdot 2^4 \Rightarrow a = 315$$

$$S_n = 2205 = 315(2^n - 1)$$

$$7 = 2^n - 1$$

$$n = 3$$

$$96) \text{ Given that } \cos(\alpha - \beta) = 1 \text{ and } \cos(\alpha + \beta) = 1/e$$

where $\alpha, \beta \in [-\pi, \pi]$

$$\text{Now } \cos(\alpha - \beta) = 1 \Rightarrow \alpha - \beta = 0 \text{ or } \alpha = \beta$$

$$\square \cos(\alpha + \beta) = 1/e \Rightarrow \cos 2\alpha = 1/e$$

$0 < 1/e < 1$ and $2\alpha \in [-2\pi, 2\pi]$ Therefore, there will be four values of α in $[-2\pi, 2\pi]$ and correspondingly four values of β . Hence, there are four sets of (α, β) .

$$\begin{aligned} 97) \quad & \alpha \in \left(\pi, \frac{3\pi}{2}\right) \quad \square \sin \alpha < 0 \text{ \& } \cos \alpha < 0 \text{ \& } \tan \alpha > 0 \\ & \sqrt{4\sin^4 \alpha + \sin^2 2\alpha + 4\cos^2 \left(\frac{\pi}{4} - \frac{\alpha}{2}\right)} \\ & = \sqrt{4\sin^4 \alpha (\sin^2 \alpha + \cos^2 \alpha) + 4\cos^2 \left(\frac{\pi}{4} - \frac{\alpha}{2}\right)} \\ & = -2\sin \alpha + 2 \left[1 + \cos \left(\frac{\pi}{2} - \alpha\right)\right] \\ & = -2\sin \alpha + 2 + 2\sin \alpha = 2. \end{aligned}$$

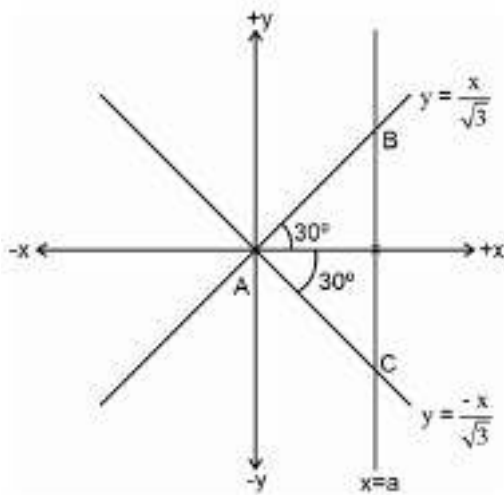
$$98) \begin{vmatrix} x & x+2y & x+3y \\ x+2y & x+4y & x+5y \\ x+4y & x+6y & x+7y \end{vmatrix} = \begin{vmatrix} x & x+2y & x+3y \\ 2y & 2y & 2y \\ 2y & 2y & 2y \end{vmatrix}$$

$$[R_{23}(-1), R_{12}(-1)] = 0 (\because R_2 = R_3)$$

$$\text{Lines are } y = \pm \frac{x}{\sqrt{3}} \text{ and } x = a$$

$\Rightarrow$ from geometry

$$99) \triangle ABC \text{ is Equilateral}$$



100) Any circle passing through the points of intersection $x^2 + y^2 - 9 + \lambda(x + y - 1) = 0$

It's centre $\left(-\frac{\lambda}{2}, -\frac{\lambda}{2}\right)$

The circle is smallest

If $\left(-\frac{\lambda}{2}, -\frac{\lambda}{2}\right)$ is on the chord $x + y = 1$

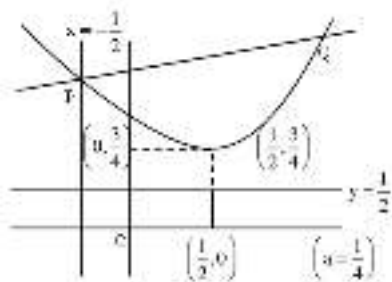
101)

P(0, 0), Q(49, 49)

Line PQ $\Rightarrow y = x$

$2bx + 3cy + 4d = 0$

$$\frac{db}{1} = \frac{3c}{-1} = \frac{4d}{0} \Rightarrow b = \frac{1}{2}, c = -\frac{1}{3}, d = 0$$



102) $\left(y - \frac{3}{4}\right) = \left(x - \frac{1}{2}\right)^2 \dots (1)$

For $x = -\frac{1}{2}$

$$y - \frac{3}{4} = 1 \Rightarrow y = \frac{7}{4} \Rightarrow P\left(-\frac{1}{2}, \frac{7}{4}\right)$$

$$y' = 2\left(x - \frac{1}{2}\right) \text{ At } x = -\frac{1}{2}$$

Now

Equation of Normal is

$$y - \frac{7}{4} = \frac{1}{2}\left(x + \frac{1}{2}\right)$$

$$y = \frac{x}{2} + 2$$

Now put y in equation (1)

$$\frac{x}{2} + 2 - \frac{3}{4} = \left(x - \frac{1}{2}\right)^2$$

$$\Rightarrow x = 2 \pm \frac{1}{2}$$

$$\Rightarrow Q(2, 3)$$

$$\text{Now } (PQ)^2 = \frac{125}{16}$$

$$103) \frac{x^2}{9} + \frac{y^2}{4} = 1$$

$$a^2 = 9 \text{ \& } b^2 = 4$$

Director circle

$$x^2 + y^2 = 9 + 4$$

$$x^2 + y^2 = 13$$

$$104) \text{ by } T = S_1$$

$$3xh - 2yk + 2(x + h) - 3(y + k)$$

$$= 3h^2 - 2k^2 + 4h - 6k$$

$$\Rightarrow x(3h + 2) + y(-2k - 3)$$

$$= 3h^2 - 2k^2 + 2h - 3k$$

If is parallel to $y = 2x$

$$\therefore \frac{(3h + 2)}{(2k + 3)} = 2$$

$$\Rightarrow 3x - 4y = 4 \text{ Ans.}$$

$$105) \left(1 + \frac{n-0}{1}\right) \left(1 + \frac{n-1}{2}\right) \left(1 + \frac{n-2}{3}\right) \dots \left(1 + \frac{n-(n-1)}{n}\right)$$

$$= \left(\frac{1+n}{1}\right) \left(\frac{1+n}{2}\right) \left(\frac{1+n}{3}\right) \dots \left(\frac{1+n}{n}\right)$$

$$= \frac{(n+1)^n}{n!}$$

$$106) (x + y^2)^{13} + (x^2 + y)^{14}$$

No. of distinct terms

$$= \text{Total terms} - \text{No. of common terms}$$

Let common terms are

$$T_{r_1+1} \text{ and } T_{r_2+1} \text{ resp. exp.}^n.$$

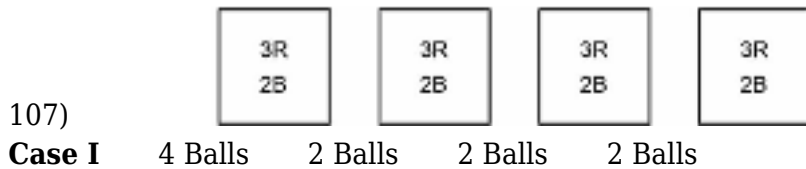
$$T_{r+1} = {}^{13}C_{r_1} x^{13-r_1} y^{2r_1}$$

$$2r_2 - r_1 = 15$$

$$3r_1 = 15 \Rightarrow r_1 = 5 \text{ and } r_2 = 10$$

So there is one common terms.

$$\Rightarrow 14 + 15 - 1 = 28$$



Class II 3 Balls 3 Balls 2 Balls 2 Balls

$$\begin{aligned}
 & {}^4C_1 [3 \text{ Red } 1 \text{ Blue } 2 \text{ Red } 2 \text{ Blue}] + \text{Case II.} \\
 & = {}^4C_1 [{}^2C_1 + {}^3C_2] ({}^3C_1 {}^2C_1)^3 + {}^4C_2 [{}^3C_2 {}^2C_1 + {}^3C_1 {}^2C_2]^2 [{}^3C_1 {}^2C_1]^2 \\
 & = 4(5) (6)^3 + 6(3 \times 2 + 3)^2 (6)^2 \\
 & = 4320 + 17496 \\
 & = 21816
 \end{aligned}$$

$$\begin{aligned}
 108) & f(x) = x^3 + 3 \text{ \& } g(x) = 2x + 1 \\
 & (g \circ f)(x) = g(f(x)) = g(x^3 + 3) = 2(x^3 + 3) + 1 \\
 & (g \circ f)(x) = 23 \\
 & 2(x^3 + 3) + 1 = 23 \\
 & x^3 + 3 = 11 \\
 & x^3 = 8 \\
 & \boxed{x = 2} \\
 & (f^{-1} \circ g^{-1})(23) = 2
 \end{aligned}$$

$$\begin{aligned}
 109) & y = 2[x] + 3 \quad y = 3[x - 2] + 5 \\
 & y = 2[x] + 3 = 3[x - 2] + 5 \\
 & \Rightarrow 2[x] + 3 = 3([x] - 2) + 5 \\
 & \quad 2[x] + 3 = 3[x] - 6 + 5 \\
 & [x] = 4 \quad x \in [4, 5) \\
 & \text{So, that } y = 2[x] + 3 = 2 \times 4 + 3 = 11 \\
 & [x + y] = [x + 11] = [x] + 11 = 4 + 11 = 15
 \end{aligned}$$

110) From graph, limit does not exist.

$$\begin{aligned}
 111) & \lim_{x \rightarrow 0} \frac{3f(x) - 4f(3x) + f(9x)}{x^2} \left(\frac{0}{0} \text{form} \right) \\
 & = \lim_{x \rightarrow 0} \frac{3f'(x) - 12f'(3x) + 9f'(9x)}{2x} \left(\frac{0}{0} \text{form} \right) \\
 & = \lim_{x \rightarrow 0} \frac{3f''(x) - 36f''(3x) + 81f''(9x)}{2} \\
 & = \frac{3f''(0) - 36f''(0) + 81f''(0)}{2} \\
 & = 24f''(0) = 24(5) = 120
 \end{aligned}$$

$$\begin{aligned}
 112) & \lim_{x \rightarrow 3^-} f(x) = \lim_{x \rightarrow 3^+} f(x) = f(3) \\
 & a\sqrt{3+1} = b(3) + 2 \\
 & 2a = 3b + 2 \quad \dots(1) \\
 & \lim_{x \rightarrow 3^-} f'(x) = \lim_{x \rightarrow 3^+} f'(x)
 \end{aligned}$$

$$\frac{a}{2\sqrt{3+1}} = b$$

$$\frac{a}{4} = b \quad \dots(2)$$

equation (1) & (2)

$$2a = 3\left(\frac{a}{4}\right) + 2$$

$$\frac{5a}{4} = 2$$

$$a = \frac{8}{5}$$

$$b = \frac{2}{5}$$

$$b = \frac{2}{5}$$

$$a + b = \frac{8}{5} + \frac{2}{5} = \frac{10}{5}$$

$$= 2$$

$$113) x^2 y^2 = a^{\frac{\pi}{2}}$$

$$2xy^2 + 2x^2y \frac{dy}{dx} = 0$$

$$\frac{dy}{dx} = \frac{-2xy^2}{2x^2y}$$

$$\frac{dy}{dx} = -\frac{y}{x}$$

$$114) \int \sqrt{1+x} \sqrt{1+(x+1)} \sqrt{x^2+6x+9} dx$$

$$= \int \sqrt{1+x} \sqrt{x^2+4x+4} dx$$

$$= \int \sqrt{1+x^2+2x} dx$$

$$= \int (x+1) dx = \frac{x^2}{2} + x + C$$

$$115) I_1 = \int_0^1 2^{x^2} dx, I_2 = \int_0^1 2^{x^3} dx,$$

$$I_3 = \int_1^2 2^{x^2} dx \text{ and } I_4 = \int_1^2 2^{x^3} dx$$

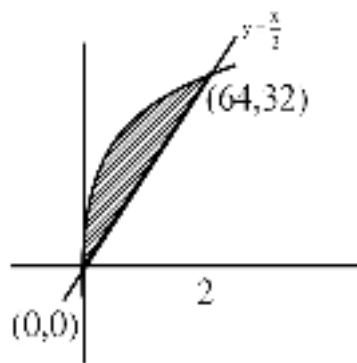
$$\therefore 2^{x^3} < 2^{x^2} \quad 0 < x < 1$$

$$2^{x^3} < 2^{x^2} \quad x > 1$$

$$\therefore I_2 < I_1 \text{ and } I_4 > I_3$$

$$116) \lim_{n \rightarrow \infty} \sum_{r=0}^n \frac{(n+r)^{1/3}}{n^{4/3}}$$

$$\begin{aligned}
 & \int_0^1 (1+x)^{1/3} dx \\
 &= 0 \\
 &= \left[\frac{3(1+x)^{4/3}}{4} \right]_0^1 \\
 &= \frac{3}{4} \cdot 2^{4/3} - \frac{3}{4}
 \end{aligned}$$



117)

$$|x-y| \leq y \leq 4\sqrt{x}$$

$$\text{Now } y = |x-y|$$

$$y^2 = (x-y)^2$$

$$\Rightarrow y = \frac{x}{2} \text{ and } x = 0$$

$$= \int_0^{64} \left(4\sqrt{x} - \frac{x}{2} \right) dx$$

Now area

$$\begin{aligned}
 &= \left[\frac{4x^{3/2}}{3/2} - \frac{x^2}{4} \right]_0^{64} = \frac{8}{3} \cdot 8^3 - \frac{64^2}{4} = 64^2 \left(\frac{1}{12} \right) \\
 &= \frac{1024}{3}
 \end{aligned}$$

$$118) \frac{1}{\sqrt{1-y^2}} \frac{dy}{dx} = x^3 - 2x \sin^{-1}y$$

$$\frac{1}{\sqrt{1-y^2}} \frac{dy}{dx} + 2x \sin^{-1}y = x^3$$

$$\text{let } \sin^{-1}y = t$$

$$\frac{1}{\sqrt{1-y^2}} \frac{dy}{dx} = \frac{dt}{dx}$$

$$\frac{dt}{dx} + 2xt = x^3$$

$$\text{I.F.} = e^{\int 2x dx} = e^{x^2}$$

□ solution is given by

$$t(e^{x^2}) = \int x^3 \cdot e^{x^2} dx + c \quad \text{let } x^2 = t$$

$$\sin^{-1}y = e^{x^2} = \int t e^t \cdot \frac{dt}{2} + c \quad 2ndx = dt$$

$$\begin{aligned} & \Rightarrow 2\sin^{-1} y \, e^{x^2} = \left(t.e^t - \int e^t dt \right) + 2C \\ & \Rightarrow 2\sin^{-1} y \, e^{x^2} = (x^2 - 1) e^{x^2} + K \\ & \Rightarrow 2\sin^{-1} y = (x^2 - 1) + K e^{-x^2} \end{aligned}$$

$$119) \sum_{\lambda=1}^{300} |A_{\lambda}| = \sum_{\lambda=1}^{300} [\lambda^2 - (\lambda - 1)^2] = (300)^2$$

120)

$$AB = BA = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} = 0$$

$$121) \vec{u} = (1, -1, -2), \vec{v} = (2, 1, -1), \vec{v} \cdot \vec{w} = 2$$

$$\vec{v} \times \vec{w} = \vec{u} + \lambda \vec{v} \dots \dots \dots (1)$$

Taking dot with $\vec{w}$ in (1)

$$\vec{w} \cdot (\vec{v} \times \vec{w}) = \vec{u} \cdot \vec{w} + \lambda \vec{v} \cdot \vec{w}$$

$$\Rightarrow 0 = \vec{u} \cdot \vec{w} + 2\lambda$$

Taking dot with $\vec{v}$ in (1)

$$\vec{v} \cdot (\vec{v} \times \vec{w}) = \vec{u} \cdot \vec{v} + \lambda \vec{v} \cdot \vec{v}$$

$$\Rightarrow 0 = (2 - 1 + 2) + \lambda (6)$$

$$\lambda = -\frac{1}{2}$$

$$\Rightarrow \vec{u} \cdot \vec{w} = -2\lambda = 1$$

$$122) \vec{r} \cdot \vec{c} = x [\vec{a} \vec{b} \vec{c}]$$

$$\vec{r} \cdot \vec{a} = y [\vec{a} \vec{b} \vec{c}]$$

$$\vec{r} \cdot \vec{b} = z [\vec{a} \vec{b} \vec{c}]$$

$x + y + z :$

$$x [\vec{a} \vec{b} \vec{c}] + y [\vec{a} \vec{b} \vec{c}] + z [\vec{a} \vec{b} \vec{c}] = \vec{r} \cdot \vec{c} + \vec{r} \cdot \vec{a} + \vec{r} \cdot \vec{b}$$

$$(x + y + z) [\vec{a} \vec{b} \vec{c}] = \vec{r} \cdot [\vec{a} + \vec{b} + \vec{c}]$$

$$(x + y + z) \left(\frac{1}{3} \right) = \vec{r} \cdot [\vec{a} + \vec{b} + \vec{c}]$$

$$(x + y + z) = 3 \left(\vec{r} \cdot [\vec{a} + \vec{b} + \vec{c}] \right)$$

$$123) \vec{AB} = (3, 5, -2)$$

direction vector $\vec{D} = (6, 2, 3)$

$$|\vec{D}| = \sqrt{6^2 + 2^2 + 3^2} = \sqrt{49} = 7$$

$$\text{projection} = \frac{(\vec{AB} \cdot \vec{D})}{|\vec{D}|}$$

$$= \frac{(18 + 10 - 6)}{7} = \frac{22}{7}$$

124)

Let equation of rotated plane be :

$$(2x + 3y + z + 20) + \lambda(x - 3y + 5z - 8) = 0$$

$$(2 + \lambda)x + (3 - 3\lambda)y + (1 + 5\lambda)z + 20 - 8\lambda = 0$$

Above plane is perpendicular to $2x + 3y + z + 20 = 0$

$$\text{So, } (2 + \lambda) \cdot 2 + (3 - 3\lambda) \cdot 3 + (1 + 5\lambda) \cdot 1 = 0 \Rightarrow \lambda = 7$$

$\Rightarrow$ Equation of rotated plane : $x - 2y + 4z - 4 = 0$

Mirror image of $A\left(2, \frac{-1}{2}, 2\right)$ in rotated plane is $B(a, b, c)$

$$\text{Equation of AB : } \frac{x-2}{1} = \frac{y+1/2}{-2} = \frac{z-2}{4} = k$$

Let coordinate of B be $\left(2 + k, \frac{-1}{2} - 2k, 2 + 4k\right)$ midpoint of AB is $\left(2 + \frac{k}{2}, \frac{-1}{2} - k, 2 + 2k\right)$ which will lie on the plane $x - 2y + 4z - 4 = 0$

$$\text{Hence } k = \frac{-2}{3}$$

$$\text{Therefore B is } \left(\frac{4}{3}, \frac{5}{6}, \frac{-2}{3}\right) \equiv \left(\frac{8}{6}, \frac{5}{6}, \frac{-4}{6}\right)$$

$$\text{So, } \frac{a}{8} = \frac{b}{5} = \frac{c}{-4}$$

125) We have $|z_k| = 1$, where $k = 1, 2, \dots, n$

$$\Rightarrow |z_k|^2 = 1 \Rightarrow z_k \bar{z}_k = 1 \Rightarrow \bar{z}_k = \frac{1}{z_k}$$

$$\square |z_1 + z_2 + \dots + z_n| = |\bar{z}_1 + \bar{z}_2 + \dots + \bar{z}_n| \quad (\square |z| = |\bar{z}|)$$

$$= |\bar{z}_1 + \bar{z}_2 + \dots + \bar{z}_n|$$

$$= \left| \frac{1}{z_1} + \frac{1}{z_2} + \dots + \frac{1}{z_n} \right|$$

$$126) \bar{z} + i\bar{w} = 0 \Rightarrow \overline{z + i\bar{w}} = 0$$

$$\Rightarrow z - iw = 0$$

$$\text{Now, } \arg(zw) = \pi$$

$$\Rightarrow \arg\left(\frac{z^2}{i}\right) = \pi$$

$$\Rightarrow \arg(z^2) - \arg(i) = \pi$$

$$\Rightarrow \arg(z) = \frac{3\pi}{4}$$

127) $n(S) = 12^6$ Now, any two months can be chosen in ${}^{12}C_2$ ways. The six birthday can fall in these two months in 2^6 ways. Out of these 2^6 ways there are two ways when all the six birthdays fall in one month so favourable number of ways in ${}^{12}C_2 \times (2^6 - 2)$.

Hence required probability is

$$= \frac{{}^{12}C_2 \times (2^6 - 2)}{12^6} = \frac{12 \times 11 \times (2^6 - 2)}{2 \times 12^6} = \frac{341}{12^5}$$

128) $C \rightarrow$ Correct

$G \rightarrow$ Guess

$K \rightarrow$ Knows

$$P\left(\frac{C}{G}\right) = \frac{1}{2}, P\left(\frac{C}{K}\right) = 1$$

$$P\left(\frac{G}{C}\right) = \frac{1}{6}$$

Let required probability = x

$$\therefore P\left(\frac{G}{C}\right) = \frac{(1-x)P\left(\frac{C}{G}\right)}{(1-x)P\left(\frac{C}{G}\right) + x.P\left(\frac{C}{K}\right)}$$

$$\frac{1}{6} = \frac{(1-x)\left(\frac{1}{2}\right)}{(1-x)\left(\frac{1}{2}\right) + (x)(1)}$$

$$\Rightarrow x = \frac{5}{7} \Rightarrow \text{Option (C) is correct.}$$

129) Here $n = 100$, $A = 50$, $\sigma = 4$

$$\text{Now, } A = \frac{\sum x}{n}; \therefore \sum x = nA = 100 \times 50 = 5000$$

Again, from the formula,

$$\sigma^2 + A^2 = \frac{\sum x^2}{n}, \text{ we get } \sum x^2 = n(\sigma^2 + A^2)$$

$$\therefore \sum x^2 = n(\sigma^2 + A^2) = 100(16 + 2500) = 251600$$

$$130) x = \sin 2\theta = 2 \sin\theta \cos\theta = \frac{4}{5}, \text{ (where } \tan\theta = 2)$$

$$y = \sin \frac{\phi}{2}; y > 0, \text{ where } \tan \phi = \frac{4}{3}$$

$$\Rightarrow y^2 = \sin^2 \frac{\phi}{2} = \frac{1 - \cos \phi}{2} = \frac{1}{5} = 1 - x$$

$$\Rightarrow y^2 = 1 - x$$